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TRANSPORTATION STATISTICS

Statystyka Transportowa.
Warsaw, 1952. Pages 3-255.   Doctor Wlodzimierz Patlikowski

TABLE OF CONTENTS

INTRODUCTION

The importance of reports and statistics has long been considerably greater in transportation than in other branches of the national economy. As a result of adapting the economy of the transport enterprises to the socialist economic system the importance of reports and statistics has increased still further in connection with economic planning and its requirements. Simultaneously the scope, tasks, and organizational forms of transport statistics have undergone substantial changes.

This handbook has been prepared from the point of view of precisely those new tasks of transportation statistics which follow from the requirements of planning.

This book is intended for the relatively large number of persons occupying directing posts in transportation, dealing with transportation planning and statistics, for planners working in the higher echelons of the statistics organizations, and for students at the schools of planning and statistics. Assuming that the abovementioned readers are acquainted with the basic points of the general theory of statistics, the first chapter of this book is limited to a closer examination of only that type of numerical data which are usually used by transportation statistics and which among other things distinguish this branch of statistics from others.

The purpose of this book is to provide the basic information necessary for the proper handling of railroad, automotive, and inland-shipping statistics.

Specifically the book provides information on the types of statistical material collected on various branches of the transportation economy, existing systems of measurement and of derived numerical characteristics, the technical-economic significance of the measurements and numerical characteristics used, and tasks and subjects of statistical processing. The methods of statistical observation used, and the collection and methods of processing statistical material, are dealt with only briefly in this book. A more detailed discussion of this subject would require special treatment.

This book discusses statistics in all the important branches of railroad, automotive, and water (inland-shipping) transportation. Rail transport receives greater space than other branches of transportation in this book for the following reasons:

1. During its relatively long history railroad statistics has adopted an increasingly large number of measurements and derived numerical characteristics, while its system -- built up by accretion over a long period -- is as a result not sufficiently compact or transparent and thus requires more detailed discussion.

2. The role of the railroad system in Polish transportation continues to be extremely large, particularly in terms of runs completed.

Finally I should like to express my thanks to those colleagues who, through making available to me certain source materials and helping me to compile the tables, have contributed to the completion of this book.

CHAPTER I. GENERAL REMARKS

A. THE SYSTEM OF RECORDS, BOOKKEEPING, AND STATISTICS IN TRANSPORTATION

1. The Significance of Statistics in a Planned Economy

The national economy in those countries which have achieved or are building socialism is based, among other things, on the direction by the state of the social processes of production, distribution, exchange, and consumption. One of the tools of this direction is economic planning.

A planned economy cannot function without thorough reliance on a proper system of records, bookkeeping, and statistics. Stalin has said: "No construction, no state work, no planning work is thinkable without proper records. And records are not imaginable without statistics. Records without statistics do not put us ahead one single step" (I. V. Stalin, Collected Works, Russian edition, Vol VI, page 214).

The essence of the system of records, bookkeeping, and statistics is the organic unity of the data supplied by it. The data of the system of records, bookkeeping, and statistics are necessary for all stages in the compilation and execution of the plan.

The compilation of the plan requires a precise knowledge of the starting state, i.e., of the state existing at the moment preceding the plan period. The plan must include data on the execution of preceding plans and must establish the relationship between planned figures and the figures of the preceding period.

Plan execution must be continually controlled and analyzed on the basis of report data. The system of records, bookkeeping, and statistics can discharge the above tasks only if it is able to fulfill the following important conditions:

1. Uniformity: consisting of a precise connection among individual elements of the system and harmonization of their data;

2. Completeness: meaning that the system must embrace all subdivisions and units making up the total national economy, and all essential social-economic phenomena. In order to provide for the conditions of uniformity and completeness the entire system must be created, organized, and directed centrally, by the state;

3. Efficiency: consisting of rapid collection of current data and applying the scope and content of the information collected to the purposes of current administration;

4. Clarity: the data collected by the system must be absolutely correct and give a true picture of conditions;

5. Scientific accuracy: the methods of observation, registration, and processing of data must be based on scientific foundations in order to provide for complete harmony and unity between practice and science.

The content and scope of the data provided by the system of records, bookkeeping, and statistics must be closely adapted to the requirements and scope of the plan.

The factor which organizes this system and gives it direction is statistics, whose peculiar advanced position is based on the following considerations:

1. Statistics is a tool in analyzing plan fulfillment;

2. Statistics reveals unutilized reserves in the national economy and provides data making it possible to avoid disproportions in the development of individual portions of the economy;

3. Statistics gives a general picture and a characterization of mass phenomena registered as concrete facts by records and bookkeeping;

4. Statistics investigates phenomena which are not embraced by records or bookkeeping.

Lenin wrote, of the role and significance of statistics: "Social-economic statistics is one of the most powerful tools of social knowledge" (Lenin, Symposium, Vol XIX, page 368).

A socialist planned economy upholds the principles of planning in relation to the entire system of records, bookkeeping, and statistics. At the same time the program, scope, content, form, and terms of statistical investigation must be fully adapted to the goals and requirements of planning. This unilateral dependence has, however, a certain well-known interdependence, since all progress in the field of statistics contributes also to the development and efficiency of planning. It follows from the above that:

1. In order to evaluate the degree of plan fulfillment it is particularly important for plan figures and the corresponding data on plan fulfillment contained in statistics to be comparable, established by the same method, using the same nomenclature, etc.

2. For the same reasons, statistics cannot compare data over a number of months or years if these data were established by different methods, if they deal with objects structured differently, or if for other reasons they are not comparable.

3. All methodological changes in planning and statistics must be first carefully weighed and coordinated in order to avoid these discrepancies.

2. Records

The term records means the recording of individual concrete facts of importance for the given installation or enterprise. Registration is usually simultaneous with the receipt of the facts, or coincides with filling out primary documents such as orders, contracts, lists, travel reports, route maps, schedules, etc.

Despite the variety of objects and methods, transport records are kept in an organized manner on prescribed forms and according to standard instructions.

Records are kept in all branches of the national economy but their significance in transportation is exceptional. The need for daily registration of an enormous quantity of data connected with the shipment of passengers and freight, data on the quantity, state, and disposition of rolling stock which is in constant movement, data connected with personnel, material, etc -- this need requires that transportation, particularly the railroads, make wide use of records.

Two different subdivisions (trends) of records are distinguished in transportation: these are operational and statistical records. Operational and statistical records embrace the same items, but from different points of view. This leaves its mark on the method of taking data, the items registered, deadlines, etc.

Operational records are based on the requirements of current work, which they mirror directly, and are usually also a part of current work. The significance of operational records in transportation is enormous, since a large portion of all registration activities in transportation is undertaken not only for the purposes of records but also comprises a definite operational activity in itself. By way of example we may mention the compilation of treasury documents, shipping invoices, information on arrivals and departures, etc. For this reason the principal efforts of registration work in transportation fall to operational records, with operational workers doing the actual work.

Statistical records are kept in the interests of planning and financing, and for research purposes. Statistical records are distinguished by their systematic nature and by their treatment of registered items as mass phenomena in order to describe them in a more general fashion.

3. Reports

The concept of reporting includes all types of documents, reports, compilations, and other work presented to superior organizational units in order to provide them with facts.

The functions of reporting are thus limited to presenting data derived from records, usually in an ordered fashion consisting of the grouping of data, addition of figures, etc. Reporting is thus not a special element in the system of records, bookkeeping, and statistics, but constitutes a sort of continuation of records. The significance of reporting in transportation is nonetheless enormous.

The organization of transport -- highly complicated spatially and functionally -- means that its reporting also comprises a great wealth of items and methods. Like the subdivision of records a distinction is made in transportation between operational and statistical reporting. This does not mean, however, that data from operational records are communicated exclusively in operational reporting.

Operational reporting is intended for purposes of direct administration. The location of the transportation process over a considerable area, and the need for precise coordination of widely separated agencies and all basic parts of a transportation enterprise, means that transportation, unlike industry, requires much more highly centralized administration and thus must base its operations on frequent and timely operational reporting.

The proper administration of transportation, particularly rail transportation, would be impossible without operational reporting, while the correctness of this administration depends to a large extent on the quality of reporting.

Statistical reporting, intended for the requirements of statistics, control, planning, and financing, embraces longer periods of time, is precise and exhaustive, and thus contains material useful for more profound analysis.

Operational reporting, which is usually done by telephone and telegraph, should be kept to the minimum necessary for operational administration, since its excessive use is unnecessary and often harmful. It should also be kept in mind that the deadlines imposed upon operational reporting sometimes make necessary certain simplifications, and even small inaccuracies are understandable under these circumstances. For this reason operational reporting must be frequently controlled by comparison with the data of statistical reporting. When deadlines are not imposed it is desirable to turn from operational reporting to statistical reporting, which gives greater guarantee of accuracy.

4. Bookkeeping

A socialist planned economy makes use of the data of bookkeeping, applies them to its needs, and in connection with the peculiar function of money in the socialist system assigns to bookkeeping definite tasks dictated by the requirements of planning. Bookkeeping has primarily the following obligations:

1. It plays a basic role in the method used for managing socialist enterprises based on khozraschet.

2. It watches over the expenditure of socially owned material and financial resources in accordance with regulations.

3. It pictures the state of permanent resources and the circulation of turnover resources and sources of financing permanent and turnover resources.

4. It registers the method of fulfilling planned goals and of achieving goals in excess of the plan, and provides a picture of the resulting financial achievements.

The importance of the above-mentioned goals of bookkeeping and their significance in the development and control of plan fulfillment mean that correct bookkeeping, in accord with requirements, is the obligation of each socialist office, enterprise, and installation.

Being governed by the general principles of bookkeeping and fulfilling the tasks assigned to it, bookkeeping registers the movement of material and financial items, presents the results of activity and the state of property in the form of an accounting of results and the balance sheet, and establishes the production costs of the operating units. Bookkeeping records are kept in chronological order.

In matters which are part of the tasks and functions of bookkeeping there is a separate standardized reporting service, made uniform by the government. It is called financial reporting.

5. Statistics

The purpose of statistics is to describe the state and development of phenomena on the basis of a large quantity of data. Statistics may deal with the most varied phenomena if these have a mass character. All the facts subjected to systematic investigation are called the statistical mass.

The mass nature of the phenomena with which statistics deals means that in its operations it must use figures even when it is dealing qualitatively with the material under investigation. Statistics is not a branch of mathematics but a separate discipline, although its methods are mathematical in nature.

Statistics therefore differs from other sciences not in the object of its investigations but in its methods, which consist basically in the following:

1. Systematically grouping the units of statistical material according to definite criteria to establish common characteristic features (numerical description).

2. Grouping and comparing the material under investigation in order to reveal existing connections and interrelations (numerical analysis).

The organization of mass investigation is based on statistical observation, i.e., on establishing and registering the facts which must be used as a basis for the development of statistical data. Observation is thus the first stage of statistical work.

Transportation statistics deal primarily with economic phenomena and thus with statistical masses which are subjected to frequent changes throughout time. Depending on the type of phenomena investigated and the requirements of the investigation the facts may be established and registered in two ways:

1. By recording the state of affairs at a definite moment in time (so-called static observation).

2. By systematic registration of changes occurring in successive time intervals (so-called dynamic observation).

In transportation statistics static observations are used in inventorying permanent resources, in establishing the initial number of freight cars, personnel, etc. According to the principles of dynamic observation, on the other hand, shipments, the operation of rolling stock, the turnover of materials in warehouses, etc, are registered. A distinction is made between the following:

1. Overall investigations embracing all installations within the limits of the group under investigation.

2. Partial investigations in which only a portion of the installations are investigated.

Partial investigations are usually cheaper than complete ones and may be carried out much more rapidly. This method is used particularly when investigations are connected with the destruction or injury of the objects being investigated, or when a complete investigation and the development of accurate results would be extremely expensive, difficult, or impossible.

One method of partial investigation is the method of representative investigation, consisting of investigating only a certain number of units of the total number, or selected such that each unit out of the total have an equal chance of representation, i.e., such that the principle of equal opportunity be retained in selection. If the portion selected is large enough it constitutes a representative group, or becomes commensurate with the entire group. Under such conditions the results obtained from a representative investigation may be generalized and extended to the entire group.

Partial investigations, particularly representative investigations, are widely used in transportation statistics. Examples are the use of this method for investigating rail traffic on individual lines, the number of passengers carried by individual passenger trains, various types of investigations of shipping statistics, etc.

Those matters which in any given transport enterprise are not included in the obligatory program of statistical investigations may be dealt with in special investigations. The investigated units within the body of collected statistical material are grouped systematically according to the criteria adopted, while the data resulting from the collection of numerical information in each group are presented in statistical tables.

The proper grouping of the units under investigation is a basic problem, and simultaneously a difficult one, since the development of statistical tables need not be limited to a mere numerical description and a characterization of the group under investigation, but may be used as an objective tool for scientific interpretation of mass phenomena.

Indivisibly connected with the quantitative and qualitative handling of mass phenomena, statistics is concerned basically with groupings which generalize the derived numerical characteristics as average figures or overall indexes; these are then transferred to tables, thus characterizing the phenomena under investigation in their basic aspects, interrelationships, and development.

B. SPECIAL FEATURES OF TRANSPORTATION STATISTICS

1. General Remarks

Transportation statistics may be defined as the use of statistical methods to investigate systems and activities connected with the displacement in space of persons and objects.

Transportation statistics, like statistics in all branches of the national economy, services the development of the national economy, the rationalization of shipping, increasing labor productivity, reducing production costs, etc.

Transportation statistics is usually called "branch" statistiss, since it relates to a specific branch of the national economy. Branch statistics has many features in common with respect to the organization of mass investigation and methods of handling the material collected; it is based fundamentally on overall statistical material. Transportation statistics reflects in addition those differences which have contributed to the isolation of transportation into a special branch of the national economy. The important dif-- ferences are the following:

1. In transportation the results of shipping cannot be isolated from the actual shipping process, which appears in all stages of the technological process of shipping and which is expressed in shipping statistics. Shipping statistics must make use not only of the number of passengers and the tons of goods transported, but also of the individual runs, expressed in complex units.

2. In other branches of the national economy the production process is basically localized, while in transportation the production process, even a simple shipment, extends over a considerable area in a basically linear fashion. Thus transportation statistics frequently uses the concepts of lines, roads, segments, etc, as the basic territorial breakdown for grouping and processing statistical material. This is reflected in statistical tables in which geographical units play a much larger role than in other branch statistics.

3. As production tools transportation uses an enormous number of rolling stock which is in constant movement. This makes it necessary to include in reports and statistics on the operation of the rolling stock a large number of units and coefficients which comprise extensive closed systems.

4. The use of the work factor takes on a specific nature in transportation; this is seen subsequently in employment statistics in which separate indexes of labor productivity are used for individual services and plant groups.

5. As regards the methods of statistical observation transportation statistics attempts to limit its activities to the minimum registration of facts necessary for statistical purposes, using as source material primarily data from the well-developed system of operational registration.

The handling of statistical material is based on the general theory of statistics in transportation statistics. Transportation statistics, however, retains certain individual features.

These features are visible primarily in the particular structure of certain units, the frequent use of so-called coefficients, and the use of only certain types of average values.

In subsequent sections we shall discuss in more detail these latter peculiarities, as well as the role of statistics in planning transportation and the subjects dealt with by transportation statistics.

2. Units of Measure in Transportation Statistics

Units are used to describe the state existing at a given moment, the scope of the results achieved, or the quantity of work accomplished in a given period of time. Transportation statistics uses simple, complex, and mean units.

Simple units include units of time, weights, measures, or certain activities (such as the shipment of a single passenger or a single unit of goods).

Complex units are those such as passmenger-kilometers, ton-kilometers, train-kilometers, axle-kilometers, car-kilometers, KM-kilometers, car-days, barge-days, etc. [HP-]

Mean units are those used to calculate certain averages such as the mean distance traveled per passenger or per ton of goods in kilometers, the mean load per freight car in tons, the average number of people per passenger-car axle, the mean gross weight of trains, etc. These mean units define primarily the qualitative aspect of these mass phenomena.

3. Derived Numerical Characteristics

Statistics is not limited to the compilation of statistical tables containing absolute figures divided into groups according to definite features, or to the compilation of tables containing so-called derived numerical characteristics, providing descriptions, comparisons, and analyses of the data compiled, or characterizing those data, particularly qualitatively.

Typical derived numerical characteristics which are frequently used in transportation statistics include average values (mean values), absolute figures, and overall indexes.

Average Values

An average is the generalized quantitative characterization of some definite feature of the units included in the group under investigation. An average may be used as a general characterization only in regard to a group which is composed exclusively of units containing the given feature being characterized. Groups of this type, homogeneous with respect to the given feature, are obtained by the method of grouping. It follows, therefore, that the word "average" should always be followed by a precise description of the concrete group to which it refers.

In current practice transportation statistics uses generally uncomplicated statistical-mathematical methods, and in relation to average values rarely goes beyond using the arithmetic mean and the weighted arithmetic mean.

Transportation statistics derives the above-mentioned means directly from general figures, summary figures, characteristics figures which are not supplemented in any other type of average and called, in the general theory of statistics, "isolated". This sometimes makes necessary a more detailed description, a more concrete presentation of certain mass phenomena connected with transportation, in the form of special supplementary investigations.

The ordinary arithmetic mean. The basic form of averages, and at the same time the most widely used form, is the ordinary arithmetic mean. This is calculated on the basis of individual characteristic elements:

$x_1, x_2, x_3 \ldots x_n$, according to the formula:

$$\bar{x}_a = \frac{x_1 + x_2 + x_3 + \ldots x_n}{n}$$

Using the short method of summation generally adopted in mathematics the above formula can be presented in the following form:

$$\bar{x}_a = \frac{\sum x}{n}$$

Example. Five trucks, each with a capacity of 4 tons, were loaded with goods weighing 3.5 tons, 3.8 tons, 4.0 tons, 4.0 tons, and 3.7 tons.

The arithmetic mean of the loaded weight per truck equaled:

$$\bar{x}_a = \frac{3.5 + 3.8 + 4.0 + 4.0 + 3.7}{5} = \frac{19.0}{5} = 3.8 \text{ tons.}$$

Statistical statements on the number of rolling stock frequently contain items such as "the average daily number of cars (vehicles) per month..." These cases also concern the ordinary arithmetic mean of the number of cars (vehicles) registered in individual days of the given month.

The weighted arithmetic mean is an arithmetic mean of figures which differ with respect to their importance in the given analysis. Thus each such figure has a "weight" determining its significance, while the weighted arithmetic mean is obtained by multiplying this number by its weight and dividing the sum of these products by the sum of weights according to the following formula:

$$\bar{x}_a = \frac{x_1m_1 + x_2m_2 + x_3m_3 + \ldots x_nm_n}{m_1 + m_2 + m_3 + \ldots m_n}$$

or a shorter method:

$$\bar{\bar{x}}_a = \frac{\sum xm}{\sum m}$$

Example 1. In the given month the following numbers of passengers were transported between station O and stations A, B, C, D, and E:

Segment	Number of Passengers	Distance (Km)
O-A	16,860	5
O-B	12,480	11
O-C	8,780	14
O-D	4,240	21
O-E	2,161	26

The (weighted) mean distance each passenger was transported in the above example equals:

$$\bar{x}_a = \frac{16,860 \times 5 + 12,480 \times 11 + 8,780 \times 14 + 4,240 \times 21 + 2161 \times 26}{16,860 + 12,480 + 8,780 + 4,240 + 2,161}$$

$$= \frac{489,726}{44,521} = 11 \text{ km}$$

The mean distance each passenger was transported, calculated in the above example without taking "weight" into account, would give an erroneous answer:

$$\frac{5 + 11 + 14 + 21 + 26}{5} = 15.4 \text{ kilometers}$$

Example 2. In the given year the following were transported:

Type of Goods	Millions of Tons	Mean Distance Carried per Ton, (Km)
Black coal and coke for export	28	510
Black coal and coke for domestic use	54	240
Stone, sand, etc	28	130
Agricultural products	11	180
Other	59	200

According to the above method of calculation the (weighted) mean mean distance of transportation per ton for the entire mass of goods equals:

$$\frac{510 \times 28 + 240 \times 54 + 130 \times 28 + 180 \times 11 + 200 \times 59}{180} = \frac{44,660}{180} =$$

$$= 248 \text{ kilometers.}$$

Relative Figures

Relative figures are obtained by dividing one of two comparable figures by the other. Relative figures are a different type of index, of which the following are the most frequently used in transportation statistics:

1. Indexes of structure. These show the relationship of the part to the whole of a given mass phenomenon and are usually expressed in percentages.

Example. Of the total number of 38,430,000 passengers who used normal-gauge railroad trains during a given month, 28,723,000 passengers traveled in suburban traffic and 9,707,000 passengers on long-distance runs. On the other hand, under the heading "Transportation by Class" 36,260,000 passengers traveled in class III and 2,170,000 in class II. This same total number of passengers will break down differently again under the heading "Type of Train Used" (local or passenger), etc.

Almost all mass phenomena, therefore, can from the point of view of particular features be divided into groups which differ in their number of elements. These groups also have different so-called specific gravities. Specific gravity is defined as the relationship of the number of elements in a given group to the total number. In the above example the specific gravity of the group of passengers in "suburban traffic" and of the group in "long-distance traffic" out of the total number of passengers equals 74.7 percent and 25.3 percent.

2. Indexes of dynamics. The mass phenomena observed in transportation change with time. These changes in consecutive periods or moments of time are expressed by:

(a) A dynamic series, expressing, for instance, the sum of operating expenses of a transportation enterprise during individual years of a particular long-range plan.

(b) A cumulative series expressing the volume of mass phenomena at a given moment of development in time, such as the length of a rail network in individual years of a given time period. In this case the changes occurring in individual years are added onto the initial state (they are accumulated).

Changes in the individual quantities contained in a dynamic or cumulative series may be expressed either in absolute figures or in indexes of dynamics.

Usually both of these methods are used simultaneously, thus presenting in one line of a dynamic or cumulative series quantities in absolute figures,and in subsequent lines the corresponding indexes.

These indexes can appear in the following two forms;

(a) Index with a constant base: in this case the size of a mass phenomenon occurring in the starting year is expressed as one or 100, while the amounts in subsequent years are eppressed in figures relative to that of the starting year.

(b) A chain index: this is a variant of the above index in which the size of a mass phenomenon in the given year is expressed in figures relative to the phenomenon in the preceding year, which is in turn taken as one or 100. In this way each year in the given series, with the exception of the last year, becomes the starting year (base year) for the following year.

3. Indexes of intensity. These are relative figures showing the relationship between different quantities which are nevertheless in a certain logical relationship, such as the length of rail lines in a given country per 100 square kilometers or per 10,000 inhabitants.

Indexes of intensity include also the so-called coefficients, of which transportation statistics and particularly statistics on the number and operation of rolling stock makes very frequent use.

Coefficients are used to evaluate results achieved or work performed in a given period of time. A coefficient represents the

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quantity, according to the existing number or achievements (work accomplished), per reference unit adopted for calculation.

Example. On a certain day the railroads had available 100,000 freight cars, or car-days. The work of the freight system on that day equaled 24,000 cars loaded in the domestic network, plus 1,000 cars from foreign railroad systems, totaling 25,000 cars (reference units).

The coefficient of mean turnaround per freight car as of that day equals: 100,000 divided by 25,000 = 4 days.

Attention should be directed toward the difference between a coefficient and an arithmetic mean. In an arithmetic mean the dividend is the sum of elements while the divisor is the number of groups of these same elements (in the same units). In coefficients, on the other hand, the divisor and the dividend contain different units, and a reference unit is adopted in the divisor for the given case.

Overall Indexes

Overall indexes, also called aggregate indexes, are a special form of relative figures. Their peculiarity lies in the fact that each of two comparable figures represents the sum of heterogeneous elements, such as the inventory of permanent resources (at two different moments of time).

In the given case the summation of heterogeneous elements of inventory is impossible; it is possible, on the other hand, to add up their value which results from multiplying the number of individual elements by the price per unit. The elements making up the total sum thus represent the products of two factors, specifically: the number of units (q) and the price per unit (p). (q and p represent, respectively, abbreviations of the French quantité and prix, meaning quantity and price.) The value of a given column of heterogeneous elements may be defined as $\sum qp$.

The overall index is calculated as the quotient of two sums ($\sum qp$) one of which refers to the report period while the other refers to the base period. There is nothing against calculating either the index for the quantity q or the index for the quantity p; but not for both quantities simultaneously.

When the index is calculated for the quantity q the value q_1 for the report period is compared with the value q_o for the base period; both of these q may contain, as a factor, either p_1 from the report period or p_o from the base period. Correspondingly it is possible to construct two variants of the so-called inex of mass dynamics (goods), specifically:

$$\frac{\sum q_1p_1}{\sum q_op_1} \quad \text{or} \quad \frac{\sum q_1p_o}{\sum q_op_o}$$

The term "goods" in the above case means the value of goods expressed in prices as of the report period (p_1) or in prices as of the base period (p_o).

In an analogous manner one may also construct the two following variants of the so-called index of price dynamics:

$$\frac{\sum q_1p_1}{\sum q_1p_o} \quad \text{or} \quad \frac{\sum q_op_1}{\sum q_op_o}$$

Example. In the base year purchases were made of 7.2 million tons of coal at 65 zlotys per ton, 100,000 tons of rail at 480 zlotys per ton, and 3,800,000 wooden ties at 24 zlotys apiece. In the report year purchases were made of 7,600,000 tons of coal at 70 zlotys per ton, 120,000 tons of rail at 600 zlotys per ton, and 3,800,000 railroad ties at 25 zlotys apiece.

The index of mass dynamics calculated according to prices in the report year for the above example is:

$$\frac{7.6 \times 70 + 0.12 \times 600 + 3.8 \times 25}{7.2 \times 70\ 2\ 0.1 \times 600 + 3.8 \times 25} = \frac{699}{659} = 1.06$$

while calculated for the base year is:

$$\frac{7.6 \times 65 + 0.12 \times 480 + 3.8 \times 24}{7.2 \times 65 + 0.1 \times 480 + 3.8 \times 24} = \frac{642.8}{607.2} = 1.059$$

The index of price dynamics calculated for the same example according to the quantity of materials purchased in the report year equals:

$$\frac{7.6 \times 70 + 0.12 \times 600 + 3.8 \times 25}{7.6 \times 65 + 0.12 \times 480 + 3.8 \times 24} = \frac{699}{642.8} = 1.087$$

and calculated according to the quantity of materials purchased in the base year equals:

$$\frac{7.2 \times 70 + 0.1 \times 600 + 3.8 \times 25}{7.2 \times 65 + 0.1 \times 480 + 3.8 \times 24} = \frac{659}{607.2} = 1.085$$

Each of the two variants presented above, i.e., that based on factors from the base year and that based on factors from the report year, may be used depending on requirements.

4. The Role of Statistics in Transport Planning

For a better picture of the role and significance of the reporting system, and particularly of statistics, in planning transportation, it is desirable to discuss in somewhat greater detail this role in the successive stages of planning.

The entire planning cycle is composed of the following stages: compilation and approval of plans; breakdown of plans to actual executors; plan fulfillment and its control; analysis of plan fulfillment.

The only stage not connected with the reporting system is the breakdown of plans to individual executors; in the remaining stages this connection is particularly close.

Compilation and Approval of Plans

The basis, and a necessary condition, of proper planning is a knowledge of the initial state, i.e., the state existing in the given transport enterprise at the beginning of the particular plan period.

The plan must then contain data on the results achieved by the transportation enterprise in the past period, goals for the planned period, and the relationship of these goals to corresponding figures at the beginning of the plan period, or the results of the preceding period. It is obvious that data on the states or achievements can be provided only by a system of reporting which means that the importance of reporting and statistics in this part of the first stage of planning is enormous.

On the other hand statistics plays only a limited role in establishing figures for the goals of the plan year.

The nature of planning must not be considered as skill in compiling plan figures based on statistical data through so-called extrapolation, i.e., through mechanical extension to the future of the results and relationships of the past. The principles of planned economy, characteristic of a socialist economy, progress, and rapid changes connected with this dynamic pace, reject this type of procedure.

This is obviously true of all transport plans, beginning with planning of shipments which establish the starting point and the principal economic foundation of other plans.

Socialist planning, which is the direction by the state of the common processes of production, distribution, exchange, and consumption, makes it possible to base shipping plans on elements obtained from the plans for the production and distribution of goods. The method used for this purpose is, to be sure, quite complex, but it gives precise and realistic results which shipping planning is obliged to use. In this connection all types of simplification must be rejected which are based on statistical extrapolation and consist for example in calculation of the planned volume of shipping on the basis of previous shipping and of the mean percentage of increase of production in the individual branches of the economy as adopted in the national economic plan. This is the more impossible since the National Plan deals with increases in the value of production and not in its volume, which alone is of importance in planning shipping.

A knowledge of statistical data plays a greater role in planning passenger transport. The factors affecting the volume, direction, and structure of passenger transport are highly varied. Other branches of the national economy cannot provide exhaustive data on passenger transportation as a result of which, in planning this branch of transport, average comparative and statistical data must be used.

In other branches of planning (in plans for the operation of rolling stock, capital repairs, investment, employment, supplies, costs, etc) statistics cannot be used as the basis for planned quantitits, but it does play a certain role in auxiliary and control work.

Control of Plan Fulfillment

The fact that statistical data cannot be the exclusive, or even the main, basis for compiling plans may lead to another equally extreme and incorrect conclusion -- that statistics plays only a passive role in following the figures connected with plan fulfillment. It must not be forgotten that the true nature of planning is not only the establishment of plan figures but, even more, the struggle to fulfill plans.

Stalin says the following of planning: "Only bureaucracy can believe that planning ends with the compilation of the plan. Compilation of the plan is only the beginning. True management of the plan does not develop until after compilation of the plan, after adjusting it to local conditions, during the correction and sharpening of the plan" (I. Stalin, Problems of Lenin, edition 10, page 413).

A weapon in the struggle to fulfill and overfulfill plans is control, the tasks of which include:

1. Seeing to it that planned goals are not only achieved but even exceeded (in a favorable sense).

2. Warning the executors of the plan whenever plan fulfillment becomes threatened for any reason.

3. During plan fulfillment discovering more reserves which can be used as a basis for overfulfilling the plan.

4. Reporting cases in which correction of individual parts of operational plans is necessary in order to avoid impeding the operation of an enterprise.

Without such an extensive system of reporting, control of plan fulfillment would be impossible.

Reporting, and particularly transport statistics, makes it possible in addition to determine whether clients have used transport media correctly, eliminating irrational shipping (such as unnecessary shipping, shipments in opposite directions, excessively long shipments, shipments intersecting incorrectly, etc), or whether they have contributed to the planned elimination of irregularities in shipping and whether they have used the transport media best adapted to the particular shipment.

Analysis of Plan Fulfillment

Plan fulfillment is analyzed at various organizational levels of a transport enterprise and at various phases of plan fulfillment.

The purpose of analysis is, among others, to establish the reasons why plan fulfillment deviates unfavorably from the planned figures, quantitatively or qualitatively, and to discover corresponding preventive media which should be applied. It needs no proof that plan fulfillment can be analyzed only on the basis of report data.

Transport statistics also contain data necessary for a comparative evaluation of the activity of the given enterprise or transport medium in various time periods, its activity in various geographic regions, and the interaction of various transport media. These comparative data are of extraordinary significance for purposes of planning and communication policy.

5. The Subjects of Transport Statistics

Among the subjects dealt with by statistics one may distinguish the following: (1) Statistics on the shipment of passengers and goods; (2) Statistics on the number, state of repair, and operation of rolling stock; (3) Statistics of employment (employment, wages, utilization of work time, work discipline, organizational forms of work, and labor productivity); (4) Statistics on the technical equipment of transportation; (5) Material statistics (supplies, materials turnover, consumption of materials and fuel); (6) Finance statistics; (7) Collective-analytic work (methods of compiling collective statistical tables and methods of collective analysis of the activity of transport media).

There is some question about so-called operational statistics. Some authors use this heading only for statistics on the number, state of repair, and operation of rolling stock, while others, on the other hand, include under this heading also statistics on technical equipment, employment, and materials.

Some authors also question the concept of finance statistics, believing that financial matters are the object of special reports and balance sheets and thus do not come under the heading of statistics.

According to I. V. Kochetov (Railroad Statistics, Moscow, 1948) the functions of financial statistics differ fundamentally from those of bookkeeping, although both disciplines are interested in the same subjects, i.e., income and expenses. Bookkeeping, however, considers the subject from the point of view of agreement with regulations concerning the expenditure of state financial resources, and is also interested in satisfying the claims of individual persons and enterprises. For statistics, on the other hand, income and expenses are basic data for evaluating and analyzing the fulfillment of the financial plan, the plan for profits and production costs, and are used simultaneously to determine the degree of dependence of financial results on various aspects of railroad activity.

The requirements of financial statistics have also been expressed in the very organization of bookkeeping. One of the principal tasks of so-called analytic bookkeeping performed separately is providing analytic numerical data for purposes of financial statistics.

The above subjects of transportation statistics may be divided into three groups:

1. The first group includes areas in which methods are used which are not encountered in statistics in other branches of the national economy; this group certainly includes statistics on the number, state of repair, and operation of rolling stock, and statistics on the amount of technical equipment of transport media.

2. The second group includes areas which have methodological sectors in common with similar areas of economic statistics. This group includes statistics on the shipment of passengers and goods, and financial statistics.

3. The third group embraces areas which, with respect to the methods used and the subjects investigated, are similar or identical to corresponding areas in other branches of the national economy. This group includes statistics on employment and materials.

C. THE ROLE OF TRANSPORTATION IN THE NATIONAL ECONOMY

The question of which branches of the national economy should be considered as material production is not decided in terms of the creation of goods as such, but rather by whether the production is based on the effect of man on nature and his efforts to adapt nature to human needs.

Transportation, as a special branch of the national economy, unquestionably participates in material production. To be sure, transportation does not create goods; it rather displaces persons and goods. This displacement consists, however, in the effect of man on nature and his efforts to adapt nature to human needs, and thus transportation fully corresponds to the criterion outlined above.

In speaking of the nature of transportation Marx (Das Kapital, Vol II, page 50) states that there exist individual branches of industry in which the outcome of the production process is not a new object, a new product, and that of these branches of industry only the communications industry is of great importance, whether in the form of the transportation industry (displacing goods and people) or in the form of the industry engaged in transporting information, letters, telegrams, etc.

When this displacement directly satisfies personal needs, the useful effect of transportation disappears simultaneously with consumption. If, on the other hand, the displacement is useful for production purposes, then the act of transportation becomes one phase in the production of goods and the useful effect of transportation is transferred to the product as an additional element in its value.

The labor consumed in transporting persons is consumed instantly to meet their needs and is not expressed in the form of permanent and separate objects.

Labor consumed in the transportation of goods, on the other hand, has much more of a production character and is materialized in the form of permanent, separate objects which, to be sure, do not represent an independent product of transportation but which possess greater utility value as a result of the displacement of the object in space through transportation.

Transportation thus creates its own special production which should be calculated separately in the total material output. Only transportation of public utility can be included in this special calculation, since it is a special branch of economic activity. Other transportation, which exists in the form of auxiliary work in industry, agriculture, construction, commerce, etc, cannot be calculated separately since the useful effects of auxiliary transportation materialize in the production of related branches of the national economy and is accounted for in them.

In all branches of material output only net production should be calculated as national income, i.e., as work newly done during the report period.

As the starting point for this purpose one may take the total material output (so-called gross production) and subtract from it the costs respresenting labor materialized previously. The remainder represents net production.

In the opinion of I. M. Krasnolobow (Planowanie i obliczanie dochodu narodowego) [Planning and the Calculation of National Income]), translation, Warsaw, 1949, gross income should be taken as gross production in transportation of public utility. Difficulties are presented, however, by the precise calculation of material costs which must be subtracted, i.e., the costs of raw materials, auxiliary materials, fuels, electric power purchased from other producers, amortization, etc. These costs do not always appear in transportation reporting in a net form; on the contrary the calculation of the costs of production in transportation frequently deals with a number of collective items embracing both current human labor and the consumption of materials, i.e., labor already previously materialized. Under these conditions the calculation of net production in transportation is extremely difficult and the results obtained should be taken with certain reservations.

The total sum of the costs enumerated in the foregoing paragraph of overall transportation should be divided by the costs of transporting goods and passengers according to the technique adopted, usually in relation to total runs expressed in ton-kilometers and passenger-kilometers.

For a comparative evaluation of the role of transportation in the national income in individual years and in order to express the physical dynamics of the volume of transportation -- net transportation -- fixed prices are used for calculation as they are for other branches of production. The most useful method for this purpose in transportation is the so-called direct calculation of gross production and net production. According to this method gross production is thet obtained by multiplying the price per ton-kilometer or per passenger-kilometer during the base year by the transportation operations accomplished during the report year, expressed in net ton-kilometers or passenger-kilometers. The costs to be subtracted for the report year are calculated separately, using base-year prices. After the above costs are deducted from gross production one obtains net production in fixed prices.

This method of calculating net production in fixed prices takes into account changes in the volume of transportation work (gross production) as well as changes in the costs subject to subtraction.

CHAPTER II. SHIPPING STATISTICS

A. INTRODUCTORY REMARKS

Shipping statistics concerns itself with internal results of transportation activity, i.e., with shipments of goods and persons. The tasks of shipping statistics include specifically investigations of the volume, structure, and direction as well as the development of shipments of passengers and goods.

The data contained in compilations of shipping statistics are of particular importance for transportation enterprises. This is because these data concern the shipping activities of the enterprise and thus represent the main basis for characterizing and evaluating the overall shipping activity of individual regional units.

The national economy attaches great importance to statistically processed lists of freight shipments. These lists contain data on goods turnover and thus illuminate and characterize spatially a number of important problems connected with the processes of distribution and resulting from the location of the productive forces of the country on the one hand and of the points of further processing or consumption on the other.

Shipping statistics, like any other part of transportation statistics, must work out its own methods of source registration, lists, and analyses, which will in the most efficient manner possible correspond to the aspects of the material investigated and to the tasks assigned to shipping statistics by the national economy and by the requirements of the transportation enterprise.

This aspect of the material with which shipping statistics operates is made up primarily of the following:

1. An unusually large number of features according to which one may describe a given type of transport, such as the name of the goods shipped, the type of shipment, the distance over which is was

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shipped, the place of origin, the destination, the weight of the shipment, the means of transportation used for the shipment, the area and volume occupied by loading, the type of train and class of car used in passenger rail transport, the speed and time of shipping, the type of rate, etc.

2. The highly dynamic and uninterrupted process of shipping.

The registration of statistical data on freight shipments should be based essentially on those shipping invoices which accompany the shipments along the way and which the enterprise retains after the shipment is completed (such as shipping schedules, etc). (The term "shipment" means that group of freight shipped under a single shipping invoice. The loading of an individual car or truck thus consists of one or more shipments.) The use of shipping invoices as statistical source material assures the reliability of data and makes a special registration unnecessary, since the number of features noted on the shipping invoices is sufficient for the purposes of proper shipping statistics. This system, furthermore, fully meets the requirements of overall registration.

The rational registration of freight shipments based on shipping invoices, however, makes it fundamentally necessary to have available a sufficient quantity of accounting machine equipment so that data can be transferred rapidly from shipping invoices to the corresponding blank forms, thus freeing shipping invoices for further control-and-accounting functions.

In the absence of accounting machine equipment statistical registration of freight shipping is performed in another manner, usually with the aid of special registration cards or lists. This obviously costs a great deal of labor and money, and increases the possibility of error.

The statistical registration of passenger shipping (shipments of passengers, baggage, and express) relies on special lists filled out by the treasurer's office concerned. The possible use for statistical purposes of tickets taken from the passengers at the end of the journey would not give results meeting the requirements of complete registration.

Some tickets entitling the holders to repeated journeys are calculated in terms of single journeys according to a formula, while trips taken on free service tickets and the like are essentially not counted at all.

Lists giving the volume of freight shipping in a given period of time refer either to the moment the shipments were sent out or to the moment of their arrival. In the former case the data on shipping are registered according to the date of departure, and in the latter case according to the date of arrival.

The moment of registration of passenger shipping is taken as the date of ticket sale. In the majority of cases this coincides with the date of the journey.

In freight shipping the counting of certain typesof shipments still requires regulation. The main problem is how to count those shipments transported by two or more means of transportation in succession, either in combined communications or with special shipping invoices in interrupted communications.

There is no question that, when shipments are handled by the same means of transportation, double counting of shipments when they are readdressed is not proper.

In the statistical lists prepared by individual types of transportation the starting point of a shipment and the destination are noted differently as, for example, stations, ports, shipping offices, etc. Sometimes the starting point and destination of a shipment within the same locality are noted by different geographical names by different means of transportation. From the point of view of systematization of all shipments according to the place of origin and destination such a state of affairs causes extra work and also requires regulation.

Statistical material is prepared in shipping statistics according to various criteria, such as the type of communications, the type of traffic, the type of freight, the features defining the region of origin or destination of a shipment (wojewodztwo, powiat, definite geographical region), the administrative-line features (station, shipping office, segment, line), etc.

B. THE DIVISIONS OF SHIPPING STATISTICS

Both transportation enterprises and the national economy are extremely interested in shipping statistics. This interest is brought about, however, by different requirements as to the content of statistical tables and the types of groupings. As a result shipping statistics has been divided into two separate sections: operational and economic.

In the operational section the statistical material is processed from the point of view of the internal needs of the transport enterprise as a producer of shipping services.

A transport enterprise must attach particularly great weight to the preparation of statistical material in such a way that a correct answer can be given to all basic questions arising from the requirements of planning and operation. This is possible if operational shipping statistics is guided by the following principles:

1. Statistical data should present the results of the shipping functions of a transportation enterprise (i.e., its produc-

tion) in sufficient detail qualitatively and quantitatively, and thus also the degree of fulfillment of plan goals.

2. Statistical data should carefully reflect uneven and irrational shipping processes which require action by the transportation enterprise with the collaboration of the interested portions of the national economy and the supervisory organs.

3. In the statistical lists the main emphasis should be placed on the relatively small number of goods which, with respect to volume, make up the great bulk of all shipments. These goods are decisive in the structure of the total volume of shipping and determine simultaneously the quantity and type of shipping resources necessary. For similar reasons the structure of passenger shipping should also be worked out.

4. The lists should simplify the presentation of the relationships existing among the size, structure, and distance of shipments and the income of the enterprise.

5. The presentation of statistical data on completed shipping should make it easier to determine whether expenditures for wages, materials, fuel, etc, have been maintained at the proper level.

Economic shipping statistics constitute a special branch of general economic statistics. The starting point for statistical lists in this branch of the discipline is not only the needs of the transportation enterprise, but may also be requirements connected with economic analysis of the entire national economy or of individual branches of it.

The location of the creative forces of the country gives rise to processes connected with the distribution of production, which are in turn reflected primarily in shipments. In this manner the quantity, type, and direction of goods shipped are a direct reflection of the economic bonds uniting individual regions of the country. The role of economic shipping statistics is thus to represent these bonds by the proper processing of statistical material concerning freight shipment. The content and system of shipping lists in economic statistics should make it easier to determine:

1. The flow of shipments, and
2. Regional transportation balances.

Operational shipping statistics and economic statistics frequently coincide in practice, since a number of data and lists are of basic importance to both branches of statistics. In any case, however, the content and system of lists in the two branches of statistics are completely different, as required by the different points of view. Under the conditions of a socialist economy, which unites all branches of the national economy into a single coherent whole, this difference in the branches of statistics obviously loses its theoretical justification, being a holdover from the period of capitalism with its lack of any overall national economic planning.

From the standpoints of operation and of objects one more division of shipping statistics is justified:

1. Statistics on passenger shipping, and baggage and express shipments carried in passenger traffic.
2. Statistics on freight shipping.

Each of these two types of shipping requires its own rolling stock, equipment, traffic organization and, to some extent, even its own service personnel. Planning in the two branches of shipping also makes use of different methods. The differences in these two branches of statistics is expressed in different features, special statistical measures, and different methods of obtaining statistical source material.

In addition to these differences, passenger and freight shipping also have a great deal in common. Both deal with the concept of transportation, with starting points and destinations, with distance shipped, etc. Many units of measure in the two branches also show numerous points in common. Thus the subheadings under which one discusses unevenness in shipping, the structure of shipments, and the flow of freight (or passengers) refer to passenger and freight shipping, respectively.

Worthy of particular note are shipments of baggage and periodicals, express shipments, etc, shipments which are quite numerous but with little total weight. In considering shipments of this type by passenger rolling stock, statistical source material is collected by a method similar to that used in passenger-shipping statistics. The statistics on shipments of this type are used primarily for the operational requirements of the transportation enterprise.

C. UNITS OF MEASURE FOR SHIPPING

1. Basic Simple and Complex Units of Measure

The following basic units of measure express the volume of shipping production:

1. Simple units:

   (a) For shipping persons: the number of passengers;

   (b) For shipping goods: the number of shipments or the quantity shipped, in tons. The total volume of shipments (freight) carried in a given time period is called the shipping mass.

2. Complex units:

   (a) For shipping persons: passenger-kilometers;

   (b) For shipping goods: ton-kilometers.

In other branches of the national economy the volume of production can be presented in isolation from the technological production process. This is not so in transportation. Data on the number of passengers carried or on the quantity of shipments transported do not in themselves indicate the effect of transportation and are not sufficient for a complete description of the results of production. This makes it necessary to use simultaneously not only simple, but also complex, units of measure, which are closely bound up with the technological production proccss.

For this purpose one must consider the so-called run, which is an expression of the process of carrying persons and goods over distances, the very essence of transportation. Runs are described quantitatively by the above complex units of measure, i.e., in passenger-kilometers and ton-kilometers. The transportation of a single passenger or a single ton of goods over a tariff distance of n kilometers equals n passenger-kilometers or n ton-kilometers. The transportation of a definite number of passengers or a definite number of tons over various tariff distances equals the total of passenger-kilometers or ton-kilometers connected with the shipment of this number of passengers or tons of goods.

The runs mentioned above therefore take into account the number of passengers carried or the quantity of freight transported, as well as the tariff distance from starting point to destination. It follows that the runs with which shipping statistics is concerned are tariff runs and, at the same time, net runs: they do not take into account tare weight, i.e., the weight of the rolling stock in which the shipment was carried.

Rolling-stock statistics in railroad transport is concerned with, among other runs, the so-called freight run in freight and passenger trains. This is obtained by multiplying the weight of the freight alone in passenger and freight trains by the actual distance covered. These runs, called operational runs, are expressed in net ton-kilometers. It should be pointed out that net operational ton-kilometers of freight shipping in freight trains do not agree numerically with tariff ton-kilometers calculated by shipping statistics, but are usually several percent higher. The difference results from the fact that net ton-kilometers in operational runs are not only calculated on the basis of statistical material different from that used for tariff ton-kilometers, but from the economical point of view is altogether different in content. This is because net operational ton-kilometers express the volume of shipping work performed by the rolling stock in carrying shipments along the route chosen. Tariff ton-kilometers, on the other hand, like passenger-kilometers, represent the internal results of the shipping functions of the enterprise, in other words production, which, according to the terms of shipping contracts, is calculated and carried out in terms of tariff distance, which is frequently shorter than the actual distance shipped.

This is to say that there is a difference in significance to a transportation enterprise between tariff runs and all other operational runs. Tariff runs together with obligatory tariff rates determine the income of the enterprise from transporting persons and freight, and should be taken into account in the plans for fulfillment, production costs, and finances. Operational runs, on the other hand, should be the baiis for plans of rolling-stock operation, material supplies, employment, and operating expenses. The results, showing the quantity and quality of rail rolling-stock operations, are also established and analyzed on the basis of operational runs.

2. Basic Mean Units of Measure

By dividing the total of passenger-kilometers or ton-kilometers transported in a given network during a given time period by the number of passengers or tons of freight carried (i.e., by the number of elements) one obtains the mean distance transported per passenger or ton of freight, in kilometers. This weighted arithmetic mean is at the same time a basic mean unit of measure.

Among the three quantities -- the volume of freight, the runs, and the mean distance transported -- there thus exists a strict relation. If two of these quantities are known the third can be found by ordinary arithmetic division.

The mean distance transported per ton, calculated for the entire mass of freight, is too general for many purposes, and must be supplemented by determinations of the mean distance transported for individual types or groups of freight out of the total mass transported. In the statistics on passenger transport, furthermore, in addition to the mean transport distance calculated for the total number of passengers, a special determination is made of the mean distance traveled per passenger in long-distance, suburban, and sometimes urban traffic.

Table 1 shows changes in the mean distance traveled per ton of shipments for certain goods which made up a significant proportion of the total mass of freight carried on normal-gauge PKP lines in 1948, 1949, 1950, and 1951.

Table 1

Mean Distance Traveled per Ton, for Important Groups of Freight Carried on the Normal-Gauge Lines of the PKP between 1948 and 1951 (In kilometers).

Freight Group	Percent of Total Freight 1948	1949	Mean Distance Traveled 1948	1949	1950	1951
1. Black coal, coke, and powdered coal: total	42.4	39.3	311.0	300.5	278.9	285.1
Destination within Poland	--	--	210.3	227.6	225.8	232.9
Destination outside Poland, traveling by land	--	--	280.9	291.9	275.5	277.8
Destination maritime ports	--	--	512.9	499.5	490.1	496.9
2. Agricultural crops	7.9	5.6	167.0	154.2	196.1	188.0
3. Stone, sand, gravel	6.8	7.8	138.1	164.7	167.6	173.4
4. Cement	1.6	1.7	257.2	271.6	279.0	274.9
5. Ore and pyrites	4.1	3.3	308.4	253.4	237.8	255.8
6. Petroleum and products	0.9	0.7	255.2	244.3	214.1	241.4
7. Chemical products	2.1	2.5	223.0	234.7	218.0	241.5
8. Timber and wood products	5.3	5.2	234.8	244.5	232.9	283.2
9. Ceramics, concrete, and glass	2.9	4.0	197.3	249.7	241.9	239.9
10. Metals, products, and scrap	4.6	4.2	190.1	188.3	196.1	197.3
Total freight			247.0	247.1	236.9	237.8

Note: The 1950 figures above are based on the first 6 months of the year; the 1951 figures on the first 9 months.

The data in Table 1 make possible the following conclusions:

1. Black coal, powdered coal, and coke represented around 40 percent of the total mass of freight carried, and thus had an enor-

mous effect on the mean distance traveled by the total amount of rail freight.

2. The mean distance traveled per ton of black coal, powdered coal, and coke for domestic consumption varied in individual years between 210 and 233 kilometers, while for foreign consumption, carried by land and sea, the distance varied between 275 and 513 kilometers. Thus the large proportion of exports of black coal and coke greatly increased the mean distance traveled per ton of shipments on the PKP. Without this export the mean distance traveled by the entire mass of freight carried, including black coal, powdered coal, and coke for domestic consumption, would be around 210 kilometers, i.e., around 26 to 37 kilometers less than the actual distance.

The economic significance of the mean distance traveled per ton of freight, calculated for individual types of goods, lies in the fact that this unit of measure represents the mean distance from the places of production of the particular goods to their places of consumption, further processing, or export. One of the purposes of planning shipments is to transport the necessary quantity of freight with the minimum expenditure of transportation work, as expressed in runs. This can be achieved by eliminating irrational shipping such as shipments in opposite directions, those incorrectly intersecting, excessively long shipments, and some repeated shipments. Internal indications of the effectiveness of the efforts made in this direction will include reductions in the mean distance traveled by individual types of freight and of the total mass of freight of handled, and thus also reductions in the total amount of transportation work.

The struggle to reduce the mean distance traveled by shipments is of enormous significance for the transportation enterprises

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and for the national economy as well. A favorable outcome to this struggle will make it possible, on the one hand, to make the necessary number of shipments with a smaller pool of rolling stock, reduced fuel consumption, less labor output, etc. On the other hand it will make possible a reduction in the expenses by the national economy connected with the movement of goods.

The mean distance traveled, being derived directly from summary figures and not being supplemented in other mean values, is assigned by the general theory of statistics to the so-called isolated means. Since for certain purposes, particularly tariffs, this mean is too general a characterization and provides too little information, the mean distance traveled requires supplementary investigations and much more detailed data. It is very important to know how the mass of freight (overall or of certain goods) breaks down to so-called distance bands, which correspond to the class divisions in a statistical distribution series. The limits of the individual distance bands in kilometers are set in terms of the requirements of the particular investigation. For each band one determines the number of tons out of the total amount transported which was carried that distance. The results of grouping the total of freight carried according to distance bands can also be expressed by fractions showing what part of the total was carried each distance. The fractions thus obtained show the so-called relative frequency. The total number of tons and the relative frequency for the individual distance bands may be presented graphically in the form of a tons curve or a frequency curve.

Passenger shipments are also grouped into distance bands according to these principles:

Tables 2 and 3, which have been set up in this fashion, give the following picture of normal-gauge rail shipments by the PKP:

1. In passenger transport the largest volume is found in the initial bands, i.e., those representing the shortest distances. As the distance traveled increases the number of passengers per band drops rapidly.

2. In freight transport the maximum volume is found in the middle bands, the limits of which, in kilometers, do not differ widely from the mean distance traveled per ton.

This is explained by the fact that passengers are transported primarily within individual economic regions or suburban areas, while freight shipment is principally the result of goods exchange among different economic regions, and thus occurs over considerably greater distances than those found for passenger transportation.

D. QUANTITATIVE NUMERICAL CHARACTERISTICS

Individual indexes of intensity, derived by shipping statistics, make it possible to characterize shipping from various points of view.

A special group is formed by indexes whose purpose is to illustrate quantitative data on shipments and to make easier a comparative evaluation of the shipping results achieved from a quantitative standpoint. This group includes:

1. Index of shipping productivity per kilometer. The value of this index is calculated by dividing the number of passengers or tons of freight carried on a given line or network in a given period of timeby the length of the line or network in kilometers.

A comparison of the value of this index, calculated for individual years for the entire transportation network of Poland and then for other countries, makes it easier to determine the connection between the volume of transportation and other factors of an economic, political, or geophysical nature.

Table 2

Transportation of Passengers by Normal-Gauge PKP Lines in 1949 and 1951, Grouped According to Distance Bands. Relative Frequency Expressed in Percents of the Number of Passengers Carried by Trains of a Given Type

Distance Bands	1949		1951	
	Express Trains	All Trains	Express Trains	All Trains
[1]	[2]	[3]	[4]	[5]
1-6	0.2	9.6	0.2	8.1
7-13	0.7	27.5	0.7	28.7
14-20	1.3	14.8	1.1	13.7
21-26	1.6	8.4	1.0	9.1
27-30	1.2	6.2	1.3	6.9
31-40	2.6	7.2	2.8	7.4
41-50	4.8	5.0	3.8	5.3
51-54	1.5	2.0	2.1	2.2
55-60	1.3	2.1	1.7	2.0
61-70	2.3	2.4	2.6	2.4
71-80	3.7	1.9	5.2	1.9
81-90	2.7	1.6	4.1	1.5
91-100	2.9	1.7	3.8	1.4
101-120	4.7	1.2	4.7	1.1
121-140	7.6	1.1	7.2	1.0
141-160	4.8	0.9	5.9	0.8
161-180	3.0	0.7	3.2	0.7
181-200	3.8	0.6	4.7	0.6
201-220	3.3	0.5	3.0	0.5
221-240	4.0	0.5	4.0	0.5
241-260	4.2	0.5	3.3	0.5
261-280	3.4	0.4	3.7	0.5
281-300	4.0	0.4	4.1	0.5

[continued]

[Table 2, continued]

[1]	[2]	[3]	[4]	[5]
301-350	9.4	0.8	7.8	0.7
351-400	5.8	0.5	4.5	0.5
401-450	3.8	0.4	3.8	0.4
451-500	3.8	0.3	3.2	0.3
501-550	3.8	0.3	3.3	0.3
551-600	1.5	0.2	1.6	0.2
601-700	1.1	0.2	0.9	0.2
701-800	0.8	0.1	0.5	0.1
801-900	0.4	--	0.2	--
901-1,000	--	--	--	--
1,001-1,100	--	--	--	--
1,101-1,200	--	--	--	--
TOTAL	100.0	100.0	100.0	100.0

Note: The number of passengers carried by express trains equals around 1.6 percent of the total number of persons transported by all types of trains.

Table 3

Transportation of Certain Types of Goods by Normal-Gauge PKP Rail Lines in 1937, Grouped According to Distance Bands. Relative Frequency Expressed in Percents of the Total Mass of Goods of the Given Kind Transported

Distance Bands (Kms) [1]	Wheat [2]	Rye [3]	Round Hardwood Timber [4]	Round Softwood Timber [5]	All Common Brick [6]
1-10	0.5	1.6	0.9	3.5	2.7
11-20	2.2	4.8	4.2	9.3	7.9
21-30	5.7	5.1	3.9	9.1	8.9
31-40	5.5	3.8	6.1	11.3	6.2
41-50	8.4	5.6	5.2	5.7	4.9

[continued]

[Table 3, continued]

[1]	[2]	[3]	[4]	[5]	[6]
51-60	4.5	3.6	5.1	5.8	5.2
61-70	5.2	3.7	4.7	7.6	2.3
71-80	3.7	2.9	3.2	4.3	2.5
81-90	2.4	2.8	3.5	4.2	2.3
91-100	2	2.5	5.1	3.9	2.3
101-150	9.9	8.6	13.6	11.5	6.7
151-200	4.9	6.8	7.7	7.8	5.3
201-250	4.1	6.1	4.8	4	10.3
211-300	3.3	4.7	3.5	1.8	11.3
301-350	3.8	3.8	2.7	1.7	9.6
351-400	2.8	3.6	2.6	1.2	4.5
401-500	4.9	7.1	4.3	1.9	4
501-600	9.5	9.9	3.6	1.6	2.1
601-700	8.9	9.8	3.6	1.7	0.5
701-800	4.3	1.9	2.6	0.9	0.4
801-900	1.4	0.5	4.8	0.8	0.1
901-1,000	1.5	0.4	2.6	0.3	--
1,101-1,100	0.5	0.3	1.6	0.1	--
1,101-1,200	0.1	0.1	0.1	--	--
TOTAL	100	100	100	100	100

Calculation of the index for individual segments, lines, or regions shows the degree to which the number of passengers or tons of freight carried in a given segment, line, or region depends on the economic structure of the area. Statistical data show that the value of this index differs depending whether the area is primarily agricultural, mixed with a preponderance of agriculture or industry, or primarily industrial. These statistical data are very important in planning new railroad lines and roads.

2. Index of shipping productivity per head of population. This index is calculated by dividing the number of passengers or tons of freight carried on the networks of a given region or on the entire network in a given period of time by the number of people living in the area or the entire country.

This index represents the mean number of trips or the mean number of tons of freight per head of population in the given region or country.

The index may be derived either for shipments made by a particular means of transportation or for shipments by all means of transportation simultaneously. The economic significance of this index is similar to that of the index of shipping productivity per kilometer.

3. Index of shipping intensity of passengers or freight per kilometer. The value of this index is calculated by dividing the number of passenger-kilometers or ton-kilometers traveled over a given line or network in a given time period by the length of the line or network in kilometers.

The value of this index derived for an entire network from the data for a given time period is an amount which in itself is still not sufficient, since similar values of the index can be obtained with a larger number of passengers or quantity of freight and a smaller average distance traveled, or with a smaller volume of goods or passengers handled but carried over a longer distance. In order to use this index for comparative purposes it is necessary first to have available the supplementary data mentioned above.

The value of the index calculated for particular segments or lines indicates the degree of utilization of those segments or lines for transportation purposes. It should be pointed out that the index is affected repeatedly and decisively not only by local arrival or departure of passengers and freight, but also by transit over the given segment or line. This explains the very high value of the index observed in railroad transport on so-called trunk lines, or on the networks of certain okręg directorates of the state railroads which are distinguished by having primarily through shipments.

This index can also be used to determine the intensity of shipment of passengers or goods.

4. Index of the mass of goods transported. This index is a relation of the total mass of a certain type of goods transported in a given time period (usually a year) to the total mass of that type of goods collected, produced, or imported; the index is expressed as a percent. This index thus defines, as a percentage, that portion of the total available quantity of a given product which, by being part of commerce, becomes an object of transportation. The index can be calculated either for shipments of the given type of goods by a certain medium of transportation, or for shipments by all means of transportation simultaneously. The value of the index calculated for the latter case will be correct only if it does not include any repeated counting of a single shipment which has been shipped by two or more means of transportation in a single journey.

Some products or groups of products require separation, resorting, and repacking in warehouses, or further processing, before they reach the final consumer. This causes repeated shipment, as a result of which the value of this particular index may exceed 100 percent. An example may be found in paper and paper products, for which the index in railroad transportation is around 400 percent.

E. NUMERICAL QUALITATIVE CHARACTERISTICS

This group also includes certain averages and indexes of intensity which characterize shipping qualitatively.

1. Mean distance traveled per ton of shipments, in kilometers. The significance of this average as a basic mean unit of measure was discussed earlier. The mean distance traveled is at the same time an important qualitative characteristic. A reduction in the mean distance traveled by goods, like the shipment of the same or a larger volume of goods with a smaller number of runs, undoubtedly represents an improvement in transportation results, providing for savings in labor and money.

Thus shipping plans should strive for a systematic reduction in the mean distance traveled by goods, primarily by eliminating irrational shipments.

2. Index of fluctuation of shipments in time.

3. Index of inequality of shipments in direction.

4. Index of range of seasonal variations.

5. The following indexes exist in railroad transportation:

(a) Average load weight intons per car or per car axle, taken statically.

(b) Average number of people per car axle in passenger cars, taken dynamically. This index will be discussed in more detail under operational statistics (in the statistics on the number and operation of rolling stock).

6. The following index is recognized in automotive transport: The coefficient of utilization of load or volume capacity of rolling stock.

7. In inland shipping the following index is used: The coefficient of utilization of loading capacity per unit of floating stock.

The significance of the qualitative characteristics mentioned under 2., 3., 4., and 5. above will be discussed in more detail in the various sections on shipping statistics and rolling-stock-operation statistics.

It follows from the foregoing that shipping statistics have an exceptionally small number of derived numerical characteristics whose sole purpose is to characterize shipping activities qualitatively. Some derived numerical characteristics used for this purpose are used simultaneously to characterize the operation of the rolling stock, and are the subject of operational statistics.

F. THE STRUCTURE OF SHIPPING

1. Grouping Shipping According to Structural Features

Section B above, "The divisions of shipping statistics", contained a discussion of factors which made it desirable to treat separately the shipment of passengers and freight. These are separate groups, homogeneous from a certain point of view, which at the same time cannot only be described quantitatively, but can also be characterized with the aid of units of measure and derived numerical characteristics used in shipping statistics.

These two groups can, however, be grouped further according to various points of view (features) determined by serious requirements of an operational, tariff, and financial nature. The groups obtained in this fashion, homogeneous with respect to the feature assumed, define the structuee (composition) of the two basic groups.

From the point of view of operational requirements it is desirable, for example, in railroad transportation to divide shipments of passengers into suburban, long-distance, and sometimes urban with an eye to the different requirements for the type of rolling stock used, the different location in time of circulating trains, etc. From the economic and tariff point of view account must be taken, among other things, of the breakdown of freight shipments into commercial, economic, and other shipments.

The above two examples show that the income and expenditures of an enterprise depend not only on the volume of freight and the number of runs, but to a large degree also on the structure of shipping. Income from carrying passengers in long-distance traffic will be structured differently from that of suburban traffic, which in practice has considerable tariff relief. Unit costs will also differ in the two instances.

As a result of the particular technical and operational differences among individual means of transportation there will be differences in the points of view (features) according to which statistical material should be grouped in terms of the structure of shipping.

The listing below is an example of some of the groupings which may be considered:

Passenger Transport

By rail:

1. Shipments by steam or electric traction.
2. Long-distance, suburban, and sometimes urban traffic.
3. Domestic, international, and transit communications.
4. Normal-gauge,lines, narrow-gauge lines.

By automobile:

1. Scheduled and irregular shipments.

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2. Direct or substitute traffic.

By inland shipping:

1. Regular, irregular, and riparian shipments.

Freight Transport

By rail:

1. Commercial, economic, and other shipments.

2. Shipments in domestic communications (including urban communications, i.e., within the confines of the network of a single okreg, or in the communications of the immediate vicinity, i.e., within the network of two or more okregs), in international communications (exports and imports by maritime and land routes), transit.

3. Shipments using rail alone or combined with other means of transportation.

4. Shipments of small goods, and carload lots.

3. Type of goods transported, etc.

6. Individual cars, groups or cars, or trains routed specially.

By inland shipping:

1. Shipments by passenger-freight ships, barges, and rafts.

2. River shipments downstream, upstream.

3. Domestic shipments, exports by maritime or inland shipping, imports by maritime or inland shipping, transit.

4. Shipments by water alone and combined with other means of transportation.

5. Shipments by owned floating stock, by rented floating stock.

6. Shipments according to type of goods transported.

By automobile:

1. Shipments in urban, line, and regional traffic.

2. Shipments by owned rolling stock, by rented rolling stock.

3. Shipments in direct, supplementary, and substitute traffic.

4. Shipments according to the type of goods transported.

Considering the many approaches to the structure of shipping, statistical lists should illuminate the structure of shipping in all necessary aspects, and should characterize it sufficiently.

The structure of shipping considered at annual intervals does not show excessive changes. Considerable oscillations in structure are found, however, depending on the season. As a result shipping statistics should not be limited to showing structure in overall annual figures, but should throw light on it also by quarters and months.

The particular importance of grouping freight shipments according to the type of goods transported will be discussed separately in section 2, below.

2. Grouping According to the Type of Goods Transported

The statistical list of goods transported is based on the tariff list of the given transport enterprise. This results from the fact that the statistical material available is either shipping invoices or special statistical records (registration cards) based on these invoices.

The detailed list of goods transported runs to tens of thousands of items. Organizing the statistical lists in the statistics of goods arranged according to type, while retaining their individual features, would be laborious and extremely costly, and entirely unnecessary for statistical purposes. Under these circumstances statistics must strive to simplify the lists by putting all the goods transported into a relatively small number of groups, or into a so-called classification.

Such a systematization of the goods transported encounters difficulties, but the classification of goods is of basic importance both for general economical statistics of shipping and for the transportation enterprise, but from different points of view.

General economical statistics on shipping attaches importance to the following:

1. The individual groups of goods should contain items related economically, such as products of mineral, agricultural, or forest origin, those produced by individual branches of industry, etc.

2. The nomenclature used in the statistics of various means of transportation should be uniform and agree wherever possible with the nomenclature used in the other branches of the national economy.

The classification of goods for transportation enterprises has a different type of importance. A distinction should be made here between the operational and the tariff points of view.

For operational purposes the classification of goods should provide information primarily on the number of rolling stock and loading equipment and the type of equipment necessary for shipping. In this connection the classification should follow a system such that the following goods be included in the statistical groups:

1. Those which are carried in equipment of the same type or even of the same capacity.

2. Those which are transported in the same months or seasons.

Shipping goods in equipment of the same type requires a different number of equipment units depending on whether the goods are loaded in the same months or seasons or at different times.

A classification limited to a relatively small number of groups of goods, listed according to the above criteria, will therefore best meet operational needs.

For tariff purposes, on the other hand, goods classification should be more highly differentiated, while the following goods should be included in the same statistical groups:

1. Goods related as to type.
2. Goods of similar economic importance.
3. Goods whose unit shipping cost is equal or nearly so.

In view of the differences between operational and tariff requirements, the classification of goods shipped should be worked out separately for each of these two purposes, taking into account the above principles of grouping.

At the present time, statistics by type of goods transported on the PKP include 261 items contained in 61 groups. This system corresponds primarily to tariff requirements.

Consideration is being given in other branches of transportation to the adoption of the railroad system of nomenclature, or a similar one, with certain simplifications adapted to the needs and peculiarities of the various means of transportation.

G. UNEVENNESS IN SHIPPING

1. Fluctuation of Shipping in Time

Various factors affect the volume of shipping at different seasons of the year. Some of these factors operate over a long period or periodically, causing long-range or seasonal changes in shipping. The effects of other factors are limited to shorter time periods; these include, for example, accidents hindering the fulfillment of certain shipping goals, atmospheric factors, etc. Changes in the volume of shipping resulting from these various factors are frequently cumulative, causing either so-called shipping peaks or breakdowns. Both cause difficulties for transportation and are highly undesirable if the rhythmic nature of shipping is to be maintained. An understanding and a description of these changes, which make up the fluctuations in shipping, are therefore of fundamental importance for transport.

The degree of fluctuation in shipping is expressed by the index of loading fluctuations and the index of fluctuation in runs. These indexes show the relation existing between the volume loaded or the number of runs in a given month and the mean monthly value throughout the year.

The indexes of shipping fluctuations can be derived only when the volume of loadings or the annual numberof runs are already known, making it possible to calculate the monthly mean. Throughout the year, on the other hand, these indexes can be calculated only approximately, by comparing the loadings or runs completed in the given month with the planned monthly mean loading or run.

The transport enterprises are particularly interested in the value of the index during the months of peak shipping volume. The degree to which shipping in the peak period may differ from the monthly mean for the same year is illustrated, for example, by the value of the index of fluctuation derived for normal-gauge PKP rail shipments during the peak autumn months (October and November); since the war the value of this index has varied for all freight shipments between 1.22 and 1.25, for commercial freight shipments between 1.16 and 1.28.

In view of the phenomenon of shipping fluctuation in time it is wrong to take a passive stand, relying on the use of material resources, employment, etc, for shipping which is variable and irregular in volume. On the contrary a responsible approach to planning shipments, particularly from the point of view of the users of transportation, should strive energetically to even out fluctuations in shipping throughout the year. Obviously this cannot result in the complete elimination of fluctuations. On the other hand the degree of these fluctuations and the periods (months) of increased shipping volume should be planned in terms of the development and requirements of the economic life of the country, and of the conditions for rational operation of the means of transportation.

A much more even allotment of shipping to individual days of the month can be achieved by a broader use of loading work on days otherwise unoccupied with work, by more careful preparation and fulfillment of operational shipping plans, etc.

2. Long-Range Trends and Seasonal Oscillations

More careful examination of the data contained in dynamic records over a period of several years, referring to shipping, will make it possible to reveal certain general developmental tendencies acting over a period of several years, as well as trends which change within a single year, according to a rhythm harmonizing with the periodic climatic cycle.

Trends observed in dynamic records and referring to developmental tendencies lasting over several years can be included in the group of long-range trends, while variations within a single 12-month period, connected with annual cyclical factors, are grouped as seasonal trends. Ten-day variations throughout the month, and daily oscillations within the week, are similar in nature to seasonal trends. Both basic types of trends will be discussed separately below.

Long-Range Trends. In countries with a socialist economic system, which is distinguished among other things by planned economy and expanded socialist production, the total volume of industrial and agricultural output, and thus also the volume of loadings and number of runs, rise systematically year by year, thus showing a long-range, unidirectional trend, increasing without cease. In countries with a capitalist economic system, on the other hand, the corresponding long-range trends show a variable picture depending on the economic situation.

Dynamic series worked out according to months, and presenting the development of shipping over a given long-range period, show not only annual changes in the intensity of these phenomena but seasonal variations as well. There are numerous methods of isolating from dynamic series a special and clear picture of long-range trends. The most important of these methods for shipping phenomena are the graphic method and the method of the sliding mean.

In the graphic method, the values relating to the volume of loading and the number of runs completed in a long-range period are transferred to a graph, showing annual and seasonal variations in such a manner as to obtain a straight line or a straight curve with the direction of the trend shown clearly. This method is not sufficiently objective, and the trend lines may ignore variations of substantial significance.

The method of the sliding mean consists in calculating the arithmetic means of a number of series containing a certain number of expressions of the dynamic series. These series are obtained in such a manner that the first includes the initial expressions of the dynamic series, leaving out the first expression of the first series and including the expression directly following the first series. In a similar manner more series are set up so long as they can be formed from a constant number of expressions. The arithmetic mean calculated for each series defines the value which we relate to the median year or month of the given series. The new dynamic series, in which the previous values are replaced by the mean values calculated in this manner, graphically presents a very smooth curve freed from large annual or seasonal variations, and thus represents more clearly the general trend in the given time period.

This method, however, does not make possible the calculation of mean values for the last several expressions of the series; this constitutes its most serious fault.

Figure 1, based on the Wiadomosci Statystyczne Glownego Urzedu Statystycznego [Statistical Information of the Main Statistical Office], No 7-8, 1950, processed according to this method, shows the 1946-1950 developmental tendencies in PKP passenger shipments.

Figure 1. Indexes of Passenger Travel on the PKP (1937 = 100). A: Passengers carried; B: 12-month sliding mean of Index A; C: Passenger-kilometers; D: 12-month sliding mean of Index C.

The long-range trends calculated by one of the above methods show that rail and automotive shipments, expressed in number of passengers and tons of freight, have shown in Poland since the war a trend toward more rapid increase than the corresponding number of runs. This phenomenon, in regard to freight shipments, can be evaluated as indicating a systematic reduction in the mean distance traveled per ton of freight. In relation to passenger shipments this tendency should be associated primarily with the more rapid increase in shipments in suburban traffic than in long-range traffic.

Seasonal Oscillations

Seasonal oscillations in the intensity of shipping are connected in Poland principally with the periodic climatic cycle during the year. The volume of seasonal variations is determined usuallyby calculating the deviations in mean monthly values over a long period of time from the overall monthly mean for that entire time period. These deviations can also be represented in percents of the overall monthly mean. The following table is an exampleof this.

Commercial Freight Shipment on Normal-Gauge PKP Lines between 1947 and 1950 (Loadings in Millions of Tons in Individual Months, According to Wiadomosci Statystyczne Glownego Urzedu Statystycznego)

Month [1]	1947 [2]	1948 [3]	1949 [4]	1950 [5]	Total [6]	Mean [7]	Deviation [8]	Deviation (%) [9]
January	4.6	6.6	7.5	9.4	28.1	7.0	-2.1	-23.1
February	3.5	6.3	7.1	9.7	26.6	6.6	-2.5	-27.5
March	4.6	7.4	9.0	12.2	33.2	8.3	-0.8	-8.8
April	5.2	7.8	9.7	10.9	33.6	8.4	-0.7	-7.7
May	6.3	7.0	9.7	11.4	34.4	8.6	-0.5	-5.5
June	6.3	7.9	10.0	11.6	35.8	8.9	-0.2	-2.2
July	7.0	8.4	10.5	11.6	37.5	9.4	+0.3	+3.3
August	6.6	8.7	10.8	12.3	38.4	9.6	+0.5	+5.5
September	7.1	9.1	11.2	12.2	39.6	9.9	+0.8	+8.8

[continued]

[Table, continued]

[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
October	7.2	10.3	13.0	13.9	44.4	11.1	+2.0	+22
November	8.1	10.4	13.0	15.1	46.6	11.6	+2.5	+27.5
December	7.6	8.5	11.1	11.7	38.9	9.7	+0.6	+6.6

The overall monthly mean for the four-year perbd equals 9,100,000 tons.

The arithmetic means for the months of a long-range period obtained in this manner represent typical monthly values, provided the intensity of shipping in the given period does not exhibit a sharply rising or falling long-range trend. The average deviations calculated show seasonal variations characteristic for the phenomenon being investigated. The average deviations given, expressed in percents of the overall monthly mean, may be used as an aid not only for analysis of seasonal variations but also for the requirements of planning freight shipping.

Of still greater value for planning purposes are similar tables of monthly values compiled for passenger transport.

3. Inequalities in Directions of Shipping

The section entitled "Flow of Passengers and Freight" (Chapter II, Section I) contains a discussion of the different intensities of the two streams of traffic developing in opposite directions along the same line. Inequalities in intensity may extend to all shipments or to only one type. This phenomenon, defined also as inequality in directions of shipping, has a negative effect on the operation of transport entewprises, causing unproductive taavel of empty units, increases in operating costs, etc.

The degree of inequality in shipping directions is defined by the index of inequality of empty and loaded shipments. This index is the relation between the number of tons of freight carried during the report period in the empty direction and the number of tons carried in the same period in the loaded direction. The value of the index is usually less than unity.

The phenomenon of inequality in directions of shipments is the result primarily of unequal disposition of the creative forces of the country and thus of the related processes of transporting finished products. This inequality cannot be entirely eliminated, but the degree of inequality must be controlled by the plan with the intention of keeping the value of this index as close as possible to unity.

H. IRRATIONAL SHIPPING

Irrational shipping is that which causes unnecessary or excessively long runs, or which complicates the work of exploitation without simultaneously increasing the runs. Irrational shipping includes particularly:

1. Shipments in opposite directions, overt or concealed. Overt shipments are those of the same goods in opposite directions along the same segment of line. Concealed shipments are those which are sent in opposite directions along different lines.

2. Shipments associated with the improper confluence or intersection of the flow of the same goods, i.e., those resulting in excessively long runs. An example is the shipment of the same steel products from Skarzysko Kamienna through Koluszki to Lodz, and from Katowice through Koluszki to Warsaw, instead of sending them from Skarzysko Kamienna to Warsaw and from Katowice to Lodz.

3. Unnecessarily long shipments, from a remote source of goods, despite the fact that the destination of the goods could be supplied with the same goods from sources located nearer.

4. Rail shipments not made by routed trains, although the possibilities for this exist.

5. Shipments for which an incorrect means of transportation is selected, although it is possible to use a more suitable means. An example is the use of rail instead of truck to ship goods to neighboring localities.

6. Double shipment, in which the same product is shipped two or more times as a result of poor organization of distribution, incorrect location of warehouses, etc.

The elimination of irrational shipments will reduce the expenditures of the national economy for shipping goods, while for the transport enterprises it is equivalent to releasing considerable shipping reserves. The solution of this problem depends on the proper planning of shipments by the users of transportation, and on proper responses from the transportation enterprises with whom the other branches of the national economy and the state supervisory organs are to collaborate.

The tasks of shipping statistics thus include the preparation of statistical lists such as to reveal irrational shipments. This work includes above all lists showing the directions taken by shipments.

I. FLOW OF PASSENGERS AND FREIGHT

Among individual economic regions of the country (industrial, agricultural, forest), and among individual wojewodztwos and powiats, there is a lively exchange of goods, consisting in the export of goods produced in the area in excess of local needs and the importation of goods not produced locally. Shipments of goods between regions are usually considerably larger than internal shipments, i.e., those which begin and end in the same region.

The exchange of goods among regions or within a region is associated with the flow of goods making up the so-called freight stream. The intensity of this stream is expressed in tons of freight carried per unit time (during a year, quarter, month, day) in a given direction through a given point, station, port, segment, line, etc.

The freight stream may be expressed either separately or combined, i.e., for a single type of freight or for all goods carried.

The intensity of freight stream at a given point on a segment or line usually differs depending on the direction taken. The direction with a greater quantity of freight, in general or of a given type, is called the loaded direction, and the opposite direction is the empty direction. In considering the stream of freight from the point of view of the rolling stockused one may observe cases in which the loaded direction for a freight car of one type is the empty direction for other types of cars.

There are several statistical and graphic methods of presenting freight streams. The more important statistical methods include the following:

1. Determination of freight flow in terms of the index of intensity of goods shipment per kilometer of individual segments, lines, etc.

2. Determination of the volume of goods turnover at hub and transloading points.

3. Correlation tables showing the flow of freight as an expression of the shipping connections among individual stations, ports, segments, areas, etc. The simplest method of compiling a correlation table is in a checkerboard, in which the "subject" of the table (i.e., "from") is the stations, lines, regions, etc, of origin of the goods, and the "predicate" (i.e., "to") is the stations, lines, etc, to which the goods were sent.

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These correlation tables are at the same time a basic tool for revealing irrational shipments.

An example of a correlation table is the fragment presented below of a so-called interdivisional and interdirectional exchange list (Table 4). Lists of this type are set up by the PKP separately for each type of goods carried. If it is shown by the lists that freight shipments of a given type were during the same time period shipped in opposite directions, such as from the Rzeszow RMO to the Lublin RMO and simultaneously from the Lublin RMO to the Rzeszow RMO, these shipments should be considered basically irrational. They can sometimes be justified by peculiar conditions, such as the need to transport in opposite directions goods of the same type but of different qualities, suitable for different concrete needs.

Table 4

Name of Goods ....

List of Interdivisional and Interdirectional Exchange for (Month and year) ....

[Items appearing in vertical column:]		[Items appearing in horizontal headings:]
Station Number	RMO and DOKP of Origin	
11	RMO Warsaw-West	Loadings, in tons
12	RMO Warsaw-Praga	Loadings, in carloads
13	RMO Siedlce	DOKP Warsaw
1	DOKP Warsaw	RMO Warsaw West
21	RMO Lublin	RMO Warsaw Prage
22	RMO Kielce	RMO Siedlce
2	DOKP Lublin	DOKP Lublin
31	RMO Krakow	RMO Lublin
32	RMO Rzeszow	RMO Kielce

[continued]

[Table 4, continued]

33	RMO Nowy Sacz	DOKP Krakow
3	DOKP Krakow	RMO Krakow
41	RMO Katowice	RMO Rzeszow
42	RMO Gliwice	RMO Nowy Sacz
43	RMO Opole	DOKP Katowice
44	RMO Rybnik	RMO Katowice
45	RMO Tarnowskie Gory	RMO Gliwice
46	RMO Bielsko	RMO Opole
47	RMO Sosnowiec	RMO Rybnik
4	DOKP Katowice	RMO Tarnowskie Gory
	etc.	RMO Bielsko
		RMO Sosnowiec
		DOKP Lodz
		RMO Lodz Kaliska
		RMO Czestochowa
		RMO Ostrow Wlkp.
		etc.

The flow of passengers is the term used for the number of passengers carried during a unit time in a given direction through a given point, segment, line, etc. The statistical determination of the flow of passengers makes use of several methods, including:

1. The index of intensity of passenger shipping per kilometer of individual segments, lines, etc.

2. The index of traffic frequency, the value of which is calculated by dividing the number of train-kilometers (car-kilometers, ship-kilometers) run over a given segment during a given time period by the length of the operating segment. After this index has been obtained the mean number of persons using the traf-

fic units, i.e., passenger trains, buses, ships, etc, should be calculated.

3. The total number of passengers in hub points (transfer points).

The flow of freight is usually presented graphically in the form of one or more dotted lines (bands) on a schematic map placed on both sides of the shipping line. The width of the band corresponds to the intensity of freight flow on the scale adopted for the particular case, and the color used denotes the type of goods transported. The flow of empty freight units is shown the same way. The position of the band with respect to the shipping line follows the customary traffic direction (right-hand traffic).

In this manner the flow of passengers may also be presented, with colors being used to show the structure of passanger shipping.

Periodically prepared numerical and graphic lists of the flow of loaded and empty rolling-stock units are very useful for the operation of a transportation enterprise, making it possible to:

1. Show the degree to which the given sector is utilized for shipping. In this connection it must be kept in mind that the volume of freight flow within the given segment is made up of:

(a) Shipments which are part oflocal shipping, i.e., which begin and end within the given segment;

(b) Shipments which originate as local shipping but go beyond the given segment;

(c) Shipments originating in other segments with a destination within the given segment;

(d) Transit shipments passing through the given segment.

2. Determine what goods and in what quantities are carried along the given sdgment, and which is the loaded and which the empty direction for these goods.

3. Picture the origins and the destinations (segments) for this flow of freight.

4. Carry out a systematic analysis of shipping operations over the individual segments.

5. Eliminate irrational freight shipments and empty rolling stock.

J. THE TRANSPORT BALANCE SHEET

The transport balance sheet is an analytical list whose purpose is to determine whether the given economic region (a territorial complex, wojewodztwo, powiat, or locality), as a result of the shipping done during the report period, shows a surplus of imports or exports with respect to a given type of goods, and the size of the surplus.

The transport balance sheet is calculated as the algebraic difference (balance) between the volume of a given type of goods dispatched and the volume of the same type of goods received during the report period (usually a year). If goods dispatched (i.e., exports) are in the majority the transport balance sheet is considered positive, and the export surplus is marked plus. If goods received (i.e., imports) are in the majority the balance is negative, and the import surplus is marked minus. When arrivals and dispatches are equal, or when both are lacking entirely, the balance is called zero.

The lists making up the transport balance sheet should take account of imports and exports by all individual means of transportation used in the given case.

An example of the tabular form of calculating a transport balance sheet is the following form (Table 5):

Table 5

Type of Transport	Dispatches (1,000 tons)			Arrivals (1,000 tons)			Transport Balance
	Total	Internal Shipments	Exports (1-2)	Total	Internal Shipments	Imports (4-5)	(3-6)
	1	2	3	4	5	6	7
1							
2							
3							
Total	4,850	2,000	2,850	5,650	2,000	3,650	-800

The plans for transport balances are compiled according to similar forms with the necessary changes. They constitute a starting point for the proper planning of shipments.

The economic statistics of shipments has the greatest interest in transport balance sheets. They are used as an aid for planning goods distribution, for planning the location of industry, etc.

The transport balance sheets are also important for transportation, particularly for economic justification of the construction of new railroad lines and roads, or of the rebuilding (expansion, improvement) of existing communications lines.

K. THE SHARE OF INDIVIDUAL MEANS OF TRANSPORTATION IN SHIPPING

Table 6 contains statistical data, expressed as percents, on shipping and runs completed by individual means of public transportation in 1948 and 1949.

The percentage share in the shipment of passengers and freight does not coincide exactly with the percentage share of the number of runs completed. This is to be ascribed to the differences in the mean distance traveled per passenger or per ton of freight by individual means of transportation. This explains why, for example, the percentage share of truck transport in freight runs completed rose considerably less rapidly than the quantity transported, and why the number of passenger runs even fell percentagewise while the number of passengers carried increased.

Table 6

Means of Transportation	Goods Carried 1948	Goods Carried 1949	Freight Runs 1948	Freight Runs 1949
PKP (normal-gauge and commuter)	96.751	94.053	98.827	98.510
Public automotive transport (PKS, etc)	2.770	5.594	0.385	0.484
Inland shipping	0.472	0.346	0.786	1.004
Air transport	0.007	0.007	0.002	0.002
Total	100.000	100.000	100.000	100.000

Means of Transportation	No of Passengers Carried 1948	No of Passengers Carried 1949	Passenger Runs 1948	Passenger Runs 1949
PKP (normal-gauge and commuter)	89.442	87.643	92.966	93.489
Public automotive transport (PKS, etc)	10.427	12.210	6.806	6.281
Inland shipping	0.114	0.132	0.123	0.134
Air transport	0.017	0.015	0.105	0.096
Total	100.000	100.000	100.000	100.000

L. STATISTICAL COMPILATIONS

The principle, mentioned in the General Remarks, of the priority of the plan over statistics, must be observed particularly strictly with regard to the shipping plan and statistics.

The shipping plan is of exceptional significance from the point of view of both the transportation enterprise and the national economy. The shipping plan is, on the one hand, an economic basis and starting point for all other detailed plans of the transportation enterprise; on the other hand this plan must provide for full satisfaction of the shipping requirements of the entire national economy in production, distribution, etc.

The strict dependence of the shipping plan on elements originating in the plan for production, distribution, etc, means that the method of compiling the shipping plan is not yet stabilized, but is rather being improved year by year. Under these conditions it is impossible to determine in a fixed manner what tables are to be processed statistically, and ho. This also explains the fact that, in regard to some matters merely discussed, the forms for statistical lists used in calculation are presented in the text, and the need for setting up lists of this type is emphasized.

The indexes to which these compilations of operational shipping statistics should correspond will be presented in greater detail in section B, The Divisions of Shipping Statistics.

CHAPTER III. STATISTICS ON THE NUMBER AND OPERATION OF ROLLING STOCK

A. INTRODUCTION

Statistics on the number and operation of rolling stock are a basic part of operational statistics. The term "operation", in the strict sense of the word, means the utilization and maintenance of the material-technical resources of an enterprise in accordance with requirements.

Operational statistics in the broader sense refers also to statistics on employment and wages, as well as to materials statistics, all of which are discussed in separate chapters.

This chapter is devoted to a discussion only of the utilization of rolling stock, specifically locomotives, cars, buses, tugboats, barges, etc.

The uninterrupted and accident-free operation of shipping and the fulfillment of the tasks associated with it in the most effective possible manner require organization of the transport enterprises such as to provide for strict collaboration of all services and all workers in the transportation enterprise, and the most effective utilization of all available material-technical resources. The results of the organizational efforts are reflected both in the productivity of the rolling stock and in labor productivity. This latter element, however, comprises another branch of statistics, the statistics of employment and wages.

Statistics on the number of rolling stock must use special methods since rolling stock, which is the principal tool of transportation work, is composed of a large number of various types of units, which are in constant movement. A knowledge of the number of units is not sufficient to depict operational results; this requires data on the number of available rolling stock, its condition, composition, and location at all times.

In order to obtain complete material on the operation of rolling stock statistical observations must be made during operations, i.e., at the point of operation of the rolling stock and as the work progressss. These data are registered on specified forms according to obligatory instructions and service regulations.

In order to describe the results of its investigations the statistics of the number and operation of rolling stock has had to develop and apply a very large number of units of measure and derived numerical characteristics. The units of measure used include:

1. Simple units, consisting of natural units (such as the number of locomotives, cars, buses, trucks, barges, etc), units of weight, measure, and time (such as kilometers, meters, tons, months, days, hours, etc), and units of certain functions (such as the number of freight cars loaded, the number of cars received loaded from other lines, etc).

2. Complex units, used principally for quantitative description:

(a) Of time, during which the rolling stock or a part of it was working or in a certain state (such as car-days, barge-days, locmmotive-hours, train-hours, etc).

(b) Of the operation of the rolling stock, in the form of so-called runs. Run units, used by the statistics of rolling-stock operation, are primarily intended to describe, quantitatively, in kilometer units:

(i) Rolling-stock traffic, specifically the number of kilometers run by the rolling stock or a portion of it. This includes units such as train-kilometers, locomotive-kilometers, car-kilometers, car-axle-kilometers KM-kilometers, etc.

(ii) Shipping operation of the rolling stock, associated with the movement of the weight both of the load carried and of the equipment itself. This unit appears only in statistics on the operation of railroad rolling stock, as "gross ton-kilometers".

(iii) The effect of traffic or shipping operations. This group of units includes ton-kilometers and passenger-kilometers, but only net ton-kilometers in the statistics of railroad rolling-stock operation.

3. Mean units, which are essentially averages, are used as units for describing the degree of utilization or the quality of operation of rolling stock (such as the average load weight in tons per freight car or freight-car axle, the average number of people per passenger-car axle or per bus, the average run per functioning locmotive per hour, etc).

The derived numerical characteristics used are averages (means) and indexes of structure and intensity: the latter appear most frequently in the form of so-called coefficients.

Both units of measure and derived numerical characteristics together form logically connected and sometimes very extensive systems. These systems have, or should have, the following features:

1. The individual units of measure should define, in simple fashion:

(a) The number, composition and condition of rolling stock at a given moment or over the report period;

(b) The quantity and quality of rolling-stock operation during the report period.

2. The derived numerical characteristics should evaluate the condition or the results achieved. They are control figures of plan fulfillment and a key to analysis.

Because of their technical and operational differences, and because of the method of operation resulting from different tasks, individual means of transportation make use of special systems of derived numerical characteristics and units of measure.

The different structures of these systems have been influenced also by the historical development of the individual means of transportation. The younger means of transportation, such as automotive, have very consistent systems, but they are as yet incomplete with respect to methods and practice.

The older means of transportation have fuller systems whose structures are filled out. The system used by the railroads, for instance, numbers around 500 units of measure and derived numerical characteristics. The systems of these older means of transportation, which are the result of a certain accumulation of units of measure and derived numerical characteristics throughout time, require more detailed connection of individual elements into a single, carefully thought out whole.

B. STATISTICS ON THE NUMBER AND OPERATION OF RAILROAD ROLLING STOCK

1. Statistical Material

The vehicles comprising the railroad rolling stock are divided into the following basic groups:

1. Freight cars.
2. Passenger cars and rail motor cars.
3. Steam, electric, and internal-combustion locomotives.

Thie breakdown refers simultaneously to statistics on the number and operation of railroad rolling stock.

Another special part of this statistics is made up of trains, which are the organizational traffic unit assuring vehicles the necessary technical conditions for performing shipping operations.

Collected statistical material includes:

1. Data on the number of locomotives, freight cars, and passenger and rail motor cars.

2. Data on the operation of rolling stock, particularly in regard to freight cars:

(a) The number of cars loaded and unloaded.

(b) The number of cars received from neighboring areas and from foreign rail systems, as well as the number of cars handed over to them.

3. Data on runs:

(a) Train runs expressed in train-kilometers and train-hours.

(b) Locomotive runs in train traffic and in other traffic, expressed in locomotive-kilometers and locomotive-hours.

(c) Car runs, expressed in car-kilometers and axle-kilometers.

(d) Runs of gross train weight and net load weight, calculated in ton-kilometers.

Data on the number and operation of freight cars are registered by the stations; on the number of locomotives by the locomotive shops; and on the number of passenger cars by the car shops (locomotive shops).

The railroad rolling stock is registered both according to certain data (i.e., according to size as of a given moment) and for a given period (i.e., according to the size of interval which may be a day, month, quarter, or year).

The method of registration for a given period is used either in a direct form (such as the sum of car-days or train-hours in a given time period) or in the form of averages derived from the numbers registered according to a series of data in a given time period.

Example. The number of freight cars for a given month is calculated as the average of the number determined as of the final hour of each day during the given month.

Data on the composition, weight, and travel of trains, and on rolling-stock runs, are registered by the train engineers, who make reports on train trips, on cars belonging to the trains, and on the operation of locomotives.

Reportsof locomotive operation are used by the okreg directorates as basic material for calculating the runs of trains, cars, car axles, the weight of trains and of loads carried, the travel time and down-time of trains, and other data dealing with the travel of locomotives and the composition and operation of trains.

Statistical material is collected according to okreg directorates for individual calendar months, and should include the work done on all lines of the given okreg directorate.

A knowledge of the length of the operational line or network in the okreg is necessary for a calculation of certain coefficients (such as the intensity of traffic, expressed in the number of train-kilometers, axle-kilometers, gross ton-kilometers per day per kilometer of operationally functioning line within the directorate okreg).

For this purpose the directorates break the lines down into segments the length and number of which depend on technical conditions and traffic intensity.

At the completion of the report month the directorate prepares the following separate reports for single-track, double-track, and multi-track lines:

1. Reports on all segments in the okreg, both active and inactive, showing their length in kilometers; in these reports the length of segments bordering with neighboring directorates in at-

tributed for purposes of statistics on rolling-stock operation, to the end stations, and not to the border points lying beyond these stations.

2. Reports on segments closed to traffic, including the date of closure and of reopening, and the length of the segments.

These data are used to derive the average daily operational length of functioning lines in the directorate okreg, using the following formula:

$$D = A - \left(B + \frac{C_1n_1 + C_2n_2 + C_3n_3}{n}\right)$$

where D = the average daily length of functioning lines, calculated separately for single-track, double-track, and multi-track segments;

A = the total length of all segments of a given type (i.e., single-, double-, and multi-track) in the okreg, functioning and not functioning;

B = the total length of non-functioning segments throughout the month (single-, double-, and multi-track segments);

C_1, C_2, C_3 = the length of segments or portions temporarily closed to traffic (for single-, double-, and multi-track lines);

n_1, n_2, n_3 = the number of days during which these segments or portions were temporarily closed to traffic;

n = the number of days in the report month.

The total average daily operational length of all functioning railroad lines in the okreg will equal the sum of the average daily operational lines of the functioning single-track, double-track, and multi-track lines. These data are given in integral numbers.

2. Freight Cars

Types of Freight Cars

The freight cars of the PKP are divided into the following seven types:

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1. Closed cars (symbol K).

2. Open cars with sides higher than 50 centimeters, so-called "coal cars" (symbol W).

3. Open cars with no sides or sides no higher than 50 centimeters, so-called "platform cars" (symbol P).

4. Cars containing reservoirs for carrying liquids, gases, etc, so-called "tank cars" (symbol R).

5. Special cars (symbol S).

6. Service cars, intended primarily for transporting mass goods for the service needs of the railroad system (symbol X, plus k, w, or p).

7. Service cars with no series denotation, but with inscriptions indicating the purpose of the car (first-aid, sanitary, snow plows, etc). When stopped at a station a car of this type is counted as not in traffic.

Cars with four and more axles are denoted by double capital letters (KK, PP, WW, etc) instead of single letters.

Freight baggage cars, denoted series Ft and intended for train service on freight trains, and closed freight cars, when adapted for carrying passengers (so-called "towos"), are part of the freight rolling stock.

Registration of the Number of Freight Cars

Registration of the number of freight cars according to the requirements of rational car management is a complicated matter, since freight cars are not only in constant movement but frequently change their status, passing from the so-called working stock of cars to the group of cars out of service, or back again, and from the stock of able cars to the group requiring repair, or disabled cars.

The highly dynamic nature of freight-car location and the particularly frequent and large changes in structure of this portion of railroad rolling stock means that the so-called inventory number of freight cars is only barely useful for car management. The inventory number of cars is derived from records of permanent resources which denote primarily features of a financial nature (value, degree of utilization, etc) of the property of an enterprise.

This type of (inventory) list is made at long time intervals on special orders of the central authorities, and follows a special procedure.

A sort of supplement to inventory records is the permanent assignment of individual freight cars to so-called home shops for periodic inspection and repairs. The home shops thus have an opportunity to record repairs made and the state of repair of the cars leaving the repair shops. This gives the records particular importance from the point of view of operational requirements as well.

Data on the number of freight cars which are actually at the disposal of a given railroad directorate on a given day or during a particular time period are provided by a special registration the purpose of which is to establish the so-called total number. This means a determination of the total number of freight cars within the okreg of the directorate as of the end of the report day.

The total number includes all freight cars, both those belonging and those notbelonging to the directorate. The total number of freight cars is divided into two groups:

1. The number of cars out of service (W), and
2. The number of working cars (R).

The freight cars which for various reasons cannot be used for shipping comprise the number of cars out of service. This consists in turn of cars:

1. Undergoing and awaiting repairs.
2. Held up at warehouses.
3. On service trains.
4. On first-aid trains.
5. For carrying passengers ("towos" cars).
6. Being sought (as well as those found and being held for use).
7. At the disposal of the military authorities.
8. Placed in reserve.
9. Leased for shipping along a side line.
10. In permanent use by other institutions.
11. Undergoing and awaiting disinfection.
12. Assigned to the service group.
13. Individual cars assigned to the exclusive use of individual services.

The remaining freight cars used for shipping make up the number of working cars (R) or the number of functioning cars. The number of working cars (R) is obtained by subtracting the number of cars out of service from the total number ($R = O - W$).

Determination of the Total Number of Freight Cars

The total number is determined the first time by listing or counting, in the field, the freight cars throughout the network. This listing or counting of the total number is repeated when necessary.

The hour of receipt of cars from neighboring directorate okregs and from foreign railroad systems, and of the delivery of cars to neighboring okregs and foreign railroads is registered by designated liaison stations (interdirectorate and frontier stations) separately for each report day.

The number of cars received on the first report day is added to the original total, and from the total obtained the number of cars delivered during the first report day is subtracted. The difference obtained will represent the total number of cars as of the final hour of the first report day of the given directorate.

The total number as of the end of each subsequent day is determined in similar fashion, i.e., by adding the number of cars received during the report day to the number remaining from the previous day and subtracting the number of cars delivered during the report day.

The total number of cars throughout the PKP network is determined by adding the number of cars received from neighboring foreign railroads during the first report day to the original total number for the entire PKP network, and by subtracting from this total the number of cars sent abroad during the first report day.

The total number of cars for the entire PKP network as of the final hour of the given report day may also be obtained by adding the totals for the individual directorates.

In determining the total number the directorates should take into account changes occurring in car inventory during the given report day:

1. Newly-built domestic and foreign cars added to PKP rolling stock are included in the total of cars received.

2. Foreign cars removed from the PKP rolling stock, and domestic cars written off the inventory, are added to the total of cars delivered.

The Ministry of Railroads calculates the transfer of cars from the PKP to foreign railroad systems and back, and makes a daily determination of the total number of cars, with a separate determination of domestic and foreign cars, for the entire PKP network.

The total figures obtained in the above manner, i.e., by calculating transfers of cars, can be said to be obtained by the balance-sheet method.

Independently of this the operational divisions and the stations carry out other forms of registration of freight cars. This has an auxiliary and control function in relation to the basic registration outlined above. This includes:

1. A register of cars received and sent out, made by the larger stations.

2. A register of freight cars to be sent out of the station.

3. A list of cars taken out of service because of damage or because the deadline has passed for the periodic inspection.

4. A booklet listing damaged PKP and foreign freight cars.

5. Reports on freight-car operations, submitted by the operational divisions and containing data on the number of operating cars and those out of service.

6. Numerical reports on freight cars out of service, submitted by the stations separately for each cause of removal from service.

The total number of freight cars mentioned earlier represents the number as of a certain date. The number of cars for a given monthly report period, on the other hand, is the so-called "average daily number of freight cars during the report month". Like the total number, the average daily number makes a distinction among:

1. The total number of cars broken down into covered, coal, platform, tank, and special cars.

2. Cars taken out of service (for repairs, reserve, service trains, and other purposes).

3. The number of operating cars broken down into categories as in 1. above.

The average daily number is calculated by dividing the sum of the total daily numbers for the whole month for each type of car by the number of calendar days in the report month. The average daily number of each type of car out of service is calculated the same way.

As the foregoing makes clear, registration based on the total number of cars shows the number in natural units (i.e., in cars), but it completely overlooks the differences in the total capacity of cars included in the total number.

Operation of Freight Cars

Each day some of the cars out of the total of operating (functioning) cars begin a new program of work, consisting in their utilization for loading, which is to be followed by shipment and unloading.

The term "car operation", for the work performed by the cars of a given okreg during a report day, in the sense accepted in freight-car management, means the total of cars loaded at okreg stations plus loaded cars received from neighboring okregs and foreign railroads during the report day.

The operation of freight cars throughout the PKP network is expressed in a similar manner: as the sum of the number of cars loaded at all PKP stations plus the number of loaded cars received by the PKP from neighboring foreign railroad systems.

The statement that the operation of freight cars means the sum of cars loaded and received in a loaded state should be supplemented by saying that the sum of loaded cars also defines the work of the given stations.

The number of loaded cars in a given network, plus those received loaded from outside, gives an approximate picture of the total volume of goods shipped in the given network. The ease and particularly the speed, of compilation of data on the number of these cars, or on the operation of freight cars, in comparison with the laborious, complicated, and lengthy processing of shipping invoices for this same purpose, guarantees a lasting and important role in railroad statistics to this method of collecting report data on freight-car operation.

By using this concept of freight-car operation to calculate the coefficient of car turnaround (defined below) it becomes possible to calculate the size of this coefficient the very day following the report day.

Data on the number of cars loaded in the given network during the past report day are compiled by the stations in so-called reports on the number and operation of freight cars. On this basis similar reports are also compiled by the operational departments for the okreg directorates, and by the directorates for the Ministry of Railroads.

Utilization of Freight Cars in Time

"Car turnaround" means essentially the time period which passes from the moment a car is presented for loading to the moment it is again presented for loading.

In the time period representing car turnaround the following functions may be distinguished:

1. The car is presented for loading.
2. The car is loaded.
3. The car waits for the train to be made up.
4. The train is made up.
5. The loaded car travels with the train.
6. The train is handled at technical stations.
7. The car is presented for unloading.

8. The car is unloaded. Depending on the situation the car may be presented for loading at the same station at which it was unloaded, thus completing the turnover; or after unloading other functions can follow:

9. The empty car waits for a train to be made up.

10. A train is made up.

11. The empty car in the train is taken to the point of next loading, together with the operations at technical stations. When the car is next presented for loading the process starts again.

Travelby empty and loaded freight cars as part of trains is registered in a manner sufficient for the requirements of statistics. There are, however, no report data on the time spent in individual functions during the time the car is waiting without a train. Registration of this kind for each car separately, so-called numerical control, would of course be costly, but it can be done at stations in which not more than 200 cars are turned around each day.

Therefore the okreg directorates control the work of larger stations through nonnumerical quantitative control. Daily the stations denoted by the directorate submit the mean down-time per car, showing how many hours, on the average, the freight cars remained at the station on the particular day, without, however, mentioning the time spent in individual functions.

The mean down-time per car at the station, in hours for the particular report day, is obtained by dividing the total down-time in car-hours by one-half the total of cars arriving and departing during the day. The total of car-hours of down-time and the number of cars arriving and departing during the report day is obtained by the station by calculating the number of car-hours on printed forms containing the following columns, plotted against hours of the report day:

1. Hours of the report day

Number of cars

2. Arriving
3. Departing

(plus those remaining from previous day)

4. Number of working cars

5. Number of hours down-time

6. Number of car-hours.

Column 1 of the form indicates hours of the report, beginning with hour 0. Column 2 contains the number of cars arriving, and column 3 the number departed, by hour. Column 4 shows, as of hour 0, the number of working cars from the previous day as of the final report hour. The numbers of working cars in subsequent hours is calculated from the data contained in columns 2 and 3, together with adding or subtracting the net of these columns from the number of working cars as of the previous hour, shown in column 4. Column 5 gives the number of hours down-time in real hours, while the total of figures from column 5 for the report day should always equal 24. Column 6 gives the number of car-hours of down-time as the product of the number of working cars in column 4 multiplied by the number of hours down-time in column 5. At the end of the day the final figures should be obtained for columns 2, 3, 5, and 6.

The number of cars taken out of service is not added to the number of cars arriving and departing; cars received from repair and disinfection are counted among those arriving, while those sent from the station to repair or disinfection after unloading are counted among departed cars.

Although this system of registering car-hours of down-time at stations still requires considerable perfection it can, in its present form, illuminate a number of problems concerning time and the causes of excessive freight-car down-time at stations, and can provide some information on the effectiveness of preventive measures.

It should be noted that stations in the USSR use a similar system of registering car-hours of down-time at stations, except that separate records are kept for cars going:

1. To loading and unloading.
2. Through the station in a routed train.
3. Through the station in a train to be remade there.

Coefficient of car turnaround. A calculation of freight-car turnaround on the basis of data derived from an exhaustive determination of the duration of each function in the shipping process, or from establishing at least the first moment in the turnaround cycle of each car, would require considerable expenditure of labor and the use of a large number of workers.

Statistically, therefore, mean freight-car turnaround time is determined in a simplified manner, based on the relationship existing among mean turnaround time, the number of cars loaded and unloaded in the network (freight-car operation), and the number of functioning (working) freight cars. This relationship consists in the fact that the product of the first two quantities equals the third quantity. If, for example, daily car loadings are to equal 200 cars with a mean turnaround time of 0.5 day, total loadings require 200 x 0.5, or 100 cars, since after 100 cars have been loaded for the first time they can, after half a day has passed, be loaded again. If, on the other hand, daily loadings are to equal 200 cars but mean car turnaround requires 3 days, the active number of freight cars needed equals 200 x 3, or 600 freight cars, since after 3 days have passed the 200 cars loaded on the first day will be ready for loading again, and can be supplied for reloading on the fourth day.

The coefficient of freight-car turnaround is calculated for the directorate okreg by dividing the working number of cars on the report day by freight-car operation, i.e., by the total of cars loaded in the particular okreg, plus loaded cars received from neighboring okregs and foreign railroads during the report day:

$$w = \frac{n}{u}$$

where w = the coefficient of freight-car turnaround in days,

n = the number of active freight cars on the report day in the particular okreg, and

u = the operation of freight cars during the report day, i.e., cars loaded in the particular okreg plus those received loaded from neighboring okregs and foreign railroads.

The coefficient of freight-car turnaround for the entire PKP network throughout the given day is obtained by dividing the number of working cars in the entire PKP network by freight-car operation, i.e., by the sum of the number of cars loaded at all PKP stations and of loaded cars received from neighboring foreign railroads during the same day.

If the coefficient of freight-car turnaround is calculated for the entire PKP network according to the formula given above:

$$w = \frac{n}{u}$$

the value of n and u will be different:

n = the number of functioning cars during the report day throughout the PKP network, and

u = freight-car operation throughout the network.

The coefficient of freight-car turnover for any okreg directorate is, under normal conditions, considerably less than the coefficient for the entire PKP network. This is the result of a number of factors, including these:

1. The average run of a loaded freight car in a train is less within a single okreg than over the entire PKP network.

2. A train containing a given freight car is remade within a single okreg at a smaller number of technical stations than throughout the PKP network.

3. Within a single okreg usually only one of these operations is accomplished, i.e., either loading or unloading.

The lower value of the coefficient for a single okreg directorate results also from the method of calculation. When the entire network is being considered the denominator u represents the number of cars loaded throughout the network plus the number received loaded from foreign railroad systems. In considering only the okreg directorate, on the other hand, u represents the number of cars loaded in the particular okreg plus cars received loaded from neighboring foreign railroad systems plus the number received loaded from neighboring okregs. It is by the amount of this last group of cars that the size of the denominator in calculations for an okreg directorate exceed the size for the total network, and this is why the coefficient is smaller for the former.

The okreg directorates differ in length of network, number of technical stations, nature of traffic, intensity of car operation, etc. As a result only the coefficients of freight-car turnaround of one and the same okreg directorate for different time periods are comparable.

The coefficient of freight-car turnaround is one of the most important indexes characterizing operations. One of the main tasks of operations is to accelerate freight-car turnaround by increasing the loading capacity of the rolling stock, which is usually accompanied by an increase in shipping capacity.

Other important derived values characterizing the intensity of exploitation of freight cars from the point of view of time economy are the following: (In subsequent paragraphs we shall speak of monthly averages, but one can analogously calculate averages for other periods, such as the year, quarter, ten-day periods, etc.)

Average run per loaded freight car, in kilometers (i.e., length of shipment). This quantity is found by dividing monthly freight-car operation into the mottnly run of loaded freight cars in passenger and freight trains expressed in car-kilometers. Length of shipment shows the average distance in kilometers over which a loaded freight car passes during a single complete turnaround cycle. Length of shipment is usually greater than the mean shipping distance, which results from the facts that:

1. In the case of freight cars containing small goods the length of shipment refers to loaded cars and not to individual shipments, which usually travel over a shorter distance.

2. The length of shipment refers to the actual distance traveled by the freight car; this may be longer than the tariff distance which is taken in calculating the mean shipping distance.

Average run per empty freight car in kilometers. This is obtained by dividing monthly freight-car operation into the monthly run of empty freight cars in passenger and freight trains, expressed in car-kilometers. This quantity shows the average distance in kilometers over which an empty freight car passes during a single complete turnaround cycle.

Average run per freight car in kilometers during a single complete turnaround cycle. This is the sum of the average run per loaded freight car and per empty car, as given above, during a single complete turnaround cycle.

Average run per freight car per day, in kilometers (loaded and empty). This is calculated by dividing the average daily number of all operating freight cars into the total number of car-kilometers showing the monthly run of loaded and empty freight cars together, on both passenger and freight trains. The quotient obtained should be divided by the number of calendar days in the given month.

According to Soviet sources the size of this mean is calculated differently in the USSR: the distance covered per car during a single turnaround cycle is divided by the number of days per cycle.

Average daily freight-car operating time in trains. This is expressed in hours and is obtained by dividing the average run per day per loaded and empty freight car (cf. above) by the average commercial speed of freight cars.

This method of calculation gives only approximate results. In order to obtain a precise value of average freight-car operating time per day in trains one should divide the average daily run per empty and loaded freight car in kilometers by the average commercial speed of freight cars and not by the average commercial speed of freight trains. The obligatory regulations concerning statistics on rolling-stock operation do not provide a special method of obtaining the average commercial speed of freight cars, which has made it necessary to replace this value by another one approximately equal to it, i.e., by the average commercial speed of freight trains.

<u>Empty Runs of Freight Cars</u>

During a single complete turnaround cycle a freight car makes a loaded run and an empty run, or only a loaded run if the next loading occurs at the unloading station and need not be sent to another station for this purpose.

There are okreg directorates which a great surplus of unloadings, from which empty cars must be sent to okregs with a surplus of loadings. This leads to streams of empty cars as a normal phenomenon connected with the location of production and sales areas.

The volume of empty runs is expressed in relative figures (or percents), giving:

1. The relationship of runs by loaded and empty cars to those of loaded cars alone.

2. The relationship of runs of empty cars to those of empty and loaded cars together.

Both the above indexes define the same phenomenon and differ only in the manner by which they care calculated.

A larger percentage of runs of empty cars indicates an increase in shipping work in comparison to net shipping output and, conversely, a smaller percentage of runs of empty cars indicates savings in shipping work, or the performance of production with a smaller output of work. This type of saving is achieved by the selection of shorter routes for empty cars, mobilizing local loadings for shipment in empty directions, eliminating counter-runs of the same type of empty cars, etc.

Utilization of Freight-Car Capacity

The degree of utilization of freight-car capacity can be characterized by a static or a dynamic unit of measure.

The static unit is the ordinary arithmetic mean which expresses the average load in tons per loaded car. This unit, which is sometimes expressed as the "average static load per freight car, in tons", is calculated by dividing the total volume transported in the given network, in tons, by the corresponding number of loaded freight cars in this network plus those received loaded from other networks. The static unit of measure can also be calculated and expressed as the average load weight in tons per freight-car axle.

The average load weight per car in tons is a variable and depends on the capacity of the freight cars in the pool, the size and length of cars, the type of loads carried, etc. The values of this average in Poland have been increasing with each passing year. This is simultaneously the result of efforts made to improve the utilization of car capacity and a consequence of gradual changes in mean freight-car capacity following on the systematic increase in the proportion of large-capacity freight cars.

In additinn this average shows frequent variations, principally seasonal, depending mainly on the type of goods shipped. Some of these goods, particularly bulky materials and small products, do not permit full utilization of the weight capacity of freight cars, although the volume capacity of a car may be completely filled.

This static unit of measure characterizes the utilization of car capacity primarily with respect to the volume transported; it says nothing of the utilization of car capacity in the sense of the relationship between car operation (car run) and the effect of this operation, i.e., the load run. This qualitative aspect of car operation is characterized by a dynamic unit which expresses the average load weight in tons per freight car or per axle during a run. This unit is also called the dynamic car (or axle) loading.

These two averages are derived by dividing the monthly total of net ton-kilometers of freight carried in freight cars in passenger and freight trains by the monthly run of loaded freight cars in these trains or by the monthly run of loaded freight-car axles in these trains, which is expressed by the formula:

$$P_d = \frac{\sum Pl}{\sum nS \text{ or } \sum ns}$$

where P_d = the dynamic unit of measure denoting the utilization of car capacity (average load weight in tons),

Pl = net ton-kilometers carried,

nS = run of loaded freight cars in car-kilometers, and

ns = run of loaded freight-car axles in car-axle-kilometers.

This formula makes it possible to derive another characteristic relationship:

$$ns = \frac{Pl}{P_d}$$

Therefore on the average load weight in tons per freight-car axle during a run depends the total number of car-axle-kilometers ($\sum ns$) necessary for accomplishing the given shipping goal, expressed in net ton-kilometers, and thus also the volume of operational expenses and the number of working freight cars.

The quantity expressed by the dynamic unit of utilization of car capacity is a weighted arithmetic mean in which the "weights" are the runs of loaded cars or the runs of loaded car axles. This dependence on the size of the run means that the quantities expressed by the dynamic unit frequently differ from the corresponding quantities given by the static unit of measure.

For example, the axle load in one car is 6 tons with a run of 400 kilometers, while in another car it is 8 tons with a run of 900 kilometers. The average load weight per loaded car axle expressed in the static unit, is:

$$\frac{6 + 8}{2} = 7 \text{ tons}$$

while in the dynamic unit it is:

$$\frac{(6 \times 400) + (8 \times 900)}{400 + 900} = 7.38 \text{ tons}$$

The value of the dynamic unit in the above example is greater than that in the static unit because the car-axle with the greater load (8 tons) performed the longer run (900 kilometers). The value of the dynamic unit is affected specifically by the following factors:

1. The composition of the shipments carried, particularly the relative proportions of runs made with mass goods, those with a high specific weight, and runs made with other goods (bulky goods, small products, etc).

2. The composition of the freight-car pool, expressed as the mean load capacity of individual groups of cars by type.

3. The degree of adherence to the technical norms obligatory in car loading.

In the case of the PKP the utilization of car capacity as expressed by the dynamic unit is always greater than that expressed by the static unit. This is the result of exports of black coal, i.e.,of a mass product over a long distance. The mean distance traveled per ton of coal on the PKP is considerably greater than the mean distance traveled by other mass goods.

On other means of transportation the utilization of capacity is expressed by the relation between net runs actually made and possible runs, provided the load capacity of the vehicles was completely utilized during the runs. On the railroads, on the other hand, the basis for determining these units is not total car-loading capacity but the number of cars or car axles, which reduces the analytical value of these units. This is a logical consequence of the application of a total number of cars obtained from another source, giving the number of freight cars in natural units (cars), but not taking into account their load capacity.

A particular expression of the utilization of freight-car load capacity is the relationship of load weight to freight-car tare weight, i.e., the car's own weight. The size of a freight train is limited on the one hand by the gross weight which can be hauled by a locomotive of given power and other shipping conditions; on the other hand it is limited by the length of available station track. An increase in the load capacity of cars without a simultaneous increase in car length, and thus in train length, can be achieved by creating a more favorable relationship between the average load weight per loaded freight car (or per loaded axle) and the average tare weight per functioning freight car (or the tare weight per car axle). These particular conditions are met by the new Soviet freight cars with high load capacity, which are supplied with equipment for automatic braking and even coupling.

The average weight per freight car in tons, or the tare weight of freight cars in trains, is, in practice, obtained by dividing the monthly run of loaded and empty freight cars in these trains into the difference between the monthly gross-weight run of freight cars in passenger and freight trains and the monthly net-load-weight run in freight cars in these trains.

The average tare weight per freight-car axle in trains is found, as above, by dividing the difference between the monthly gross-weight car run and monthly net-load-weight run by the monthly run per loaded and empty freight-car axle.

<u>Productivity of Freight Cars</u>

Average freight-car productivity is measured by the number of runs of the weight per freight-car axle or per freight car, during the report period, in the given freight-car pool.

Depending on the purpose for which freight-car productivity is being determined one may take into account cars in the total pool, or the working cars, or even the number of so-called able cars. As load runs to express car productivity one may use net (operational) ton-kilometers or gross ton-kilometers. Tariff ton-kilometers are not used for this calculation.

This index of freight-car productivity and the coefficient of freight-car turnaround are the two most important derived values providing a qualitative characterization of the work done by the particular freight-car pool during the report period.

3. Passenger Cars

Breakdown of Passenger Cars

In terms of the purposes for which they are used passenger cars are divided into:

1. Cars for carrying passengers.

2. Cars for carrying passenger baggage, express shipments, and special delivery shipments.

3. Cars for carrying mail.

4. Cars for special purposes.

Baggage-mail cars, which are not included in the above breakdown, are used for transporting baggage and mail in separate compartments. They are included in the category of cars for carrying mail.

Special passenger cars include parlor and service cars, sleeping cars, dining cars, hospital cars, and heating cars.

Passenger cars for carrying passengers are divided into first, second, and third classes. Mixed cars also exist. Depending on their use and equipment passenger cars are marked with symbols composed of large and small letters, denoting series. At present around 75 series are used on the PKP.

Number of Passenger Cars

The assignment of passenger cars to individual okreg directorates depending on traffic requirements is handled by the Ministry of Railroads. The okreg directorate then assigns passenger cars as inventory to individual car shops or locomotive shops, and allots them home stations.

The Ministry of Railroads keeps the inventory book of passenger cars, in the sense of financial records of permanent resources. The Ministry of Railroads and the okreg directorates keep operational records of passenger cars in the form of a "card file of passenger cars", and the car shops (locomotive shops) keep them in the form of a "card file of individual passenger cars". The cards in these card files are marked on the front with headings giving a technical description of the car, while the back contains a register of dates, places, and types of repairs and structural changes made, in addition to space for writing the name of the okreg directorate under which the passenger car is at the moment.

On the last day of each month the home car shops (locomotive shops) compile a "report on the number and condition of passenger cars" for their operational divisions and the okreg directorates, while the directorates in turn submit similar reports to the Ministry of Railroads.

These reports are basic statistical material for determining the number of passenger cars, and are a basis for making changes in card-file records. The number of passenger cars of each type is specified by the car shops (locomotive shops) in their reports as follows:

The number of functioning cars available for traffic is obtained by subtracting from the total number:

1. The cars taken out of service and sent for repair.

2. The cars taken out of service and placed in reserve on orders from the Ministry of Railroads.

3. The cars taken out of service to provide office space and housing and for various other reasons.

In a similar manner, on the basis of reports from subordinate car shops (locomotive shops) the directorates determine the numbers of passenger cars for their okregs.

As of a definite day and hour, on orders of the Ministry of Railroads, a numerical list of passenger cars is made in order to determine:

1. The total number of passenger cars throughout the PKP network.

2. The number of passenger cars belonging to the PKP.

3. The number of passenger cars belonging to foreign railroad systems.

4. The number of passenger cars in individual series.

5. The whereabouts of passenger cars being sought.

Lists are made of all passenger cars (with the exception of those eliminated from the inventory) wherever they are at the moment of the listing. Cars in trains which are at that moment traveling are listed by the train engineer. Passenger cars which during the listing are outside Poland are included in the listing by the okreg (home) directorates.

Utilization of Passenger Cars

The degree of utilization of the carrying capacity of passenger cars during a given time period, or the "population of passenger cars", is determined by a mean unit of measure, the so-called average population per passenger-car axle. The size of this mean for the particular report period is obtained by dividing the number of passenger-kilometers run by the total run of passenger cars, expressed in axle-kilometers.

This calculation is usually made only for passenger cars intended for carrying passengers, i.e., leaving out the axle-kilometers run by baggage, mail, and other cars.

For operational purposes use is also made of data on passenger-car population registered by conductors. Frequently, however, these data are not sufficiently accurate.

A mean characterizing the utilization of time by the passenger cars is the average daily run per passenger car. This is found by dividing the passenger-car run made during the given time period by the total number of car-days available during the same period.

These mean values (for population and daily run) are obtained separately for long-distance and suburban traffic because of the great differences in the nature of the two types of traffic and in the mean values obtained for them.

The average population in long-distance traffic usually does not exceed 10 persons per car-axle, while in suburban traffic this value is usually several times as great. Thus the population of all passengers together depends not only on the degree of actual usage of long-distance trains but also on the proportion of suburban traffic to total traffic.

Productivity of Passenger Cars

The average productivity of passenger cars is determined by the number of passenger-kilometers per passenger-car axle or per passenger car of the particular pool during the report period. Depending on the purposes of the productivity determination one may use either the total (available) number of cars or the number of functioning cars.

For the reasons given in the discussion of the mean values characterizing the utilization of passenger cars these indexes of passenger-car productivity should be derived separately for long-distance and suburban traffic.

The index of passenger-car productivity is the most important derived value characterizing the economic effect of the particular passenger-car pool during the report period. In cases in which the size of this index exceeds the number of passenger-kilometers run under normal conditions the large index must be viewed unfavorably, since it reflects minimum passenger convenience.

It should be added that expressing passenger-car productivity in load runs (gross or net ton-kilometers) would not give a true picture, because of the particular use to which passenger cars are put.

4. Locomotives

Breakdown of Locomotives

In view of the specialization of locomotives as a result of their use in different types of trains, locomotives are divided into the following three groups:

1. Express locomotives (P), used for high-speed and express trains.

2. Passenger locomotives (O).

3. Freight locomotives (T).

Within each of these groups several types are distinguished depending on the arrangement of free and driving axles. Each type is divided into a number of series each with locomotives of identical design and power. In 1948 the PKP had around 40 or 50 different locomotive series.

Apart from the above breakdown, passenger and freight locomotives are divided into those with tenders and those without (so-called "tendrzaki"). Passenger tenderless locomotives are used principally for suburban service, while tenderless freight locomotives are used for switching, although locomotives with tenders can actually be used here.

Number of Locomotives

Locomotives are assigned permanently to okreg directorates, and, within each directorate, to main locomotive shops, where they are part of the inventory. The number of inventory locomotives is calculated according to the number of permanent trains and the amount of regular auxiliary locomotive work. In calculating the necessary inventory the number of functioning locomotives is increased by around 15 percent for replacement of disabled locomotives and around 5 percent for reserve.

By subtracting from the number of inventory locomotives the number lent temporarily to another directorate or main locomotive shop and adding the number of locomotives borrowed temporarily from other okreg directorates or locomotive shops one obtains the total number of locomotives in the given directorate or locomotive shop.

By subtracting from the total number of locomotives those held out of service and those made available to non-railroad units one obtains the number of available locomotives in the given directorate or locomotive shop.

Depending on their condition (operability) the available locomotives are divided into able and disabled.

Able locomotives, depending on the manner in which they are used, are divided into:

1. Functioning locomotives, which perform work expressed in locomotive-kilometers.

2. Locomotives whose boilers are being cleaned, and which are therefore nonfunctioning.

3. Locomotives out of service and in reserve. This group includes locomotives which are not functioning for lack of work.

4. Locomotives used as permanent boilers for cleaning other boilers, heating, etc.

Disabled locomotives are divided into:

1. Locomotives under repair.

2. Locomotives awaiting repair.

3. Locomotives incapable of use, awaiting removal from the inventory list (locomotives on which special reports have been made and the decision taken to remove them from inventory lists).

The average daily number of functioning locomotives is obtained by dividing the monthly total of locomotive-days worked by all functioning locomotives by the number of calendar days in the month.

A locomotive-day of work is, for this purpose, any calendar day during which a locomotive functioned for at least one hour.

Breakdown of Locomotive Operation

The operation of a locomotive in the physical sense is a function of the tractive power of the locomotive and the distance covered during a unit time, or the speed of the locomotive. The power of the locomotive in this sense depends on its weight, boiler efficiency, and the power of the steam engine.

Locomotive operation in the active sense means various uses of a locomotive for enterprise requirements. Statistics on locomotive operation are concerned only with actual locomotive operation expressed in locomotive-kilometers, which includes:

1. Locomotive operation in train service, and

2. Non-train locomotive operation.

So-called substitute operation of locomotives is not given in locomotive-kilometers and is not included in locomotive-operation statistics.

Locomotive operation in train service, or the operation of a locomotive servicing trains, is divided into:

1. Basic work, including hauling the train, regardless of whether the locomotive is used as a so-called train locomotive or as a pusher or additional hauling engine.

2. Supplementary work, including train switching, heating the train, and reserve, and traveling empty in order to pick up a train.

Non-train locomotive operation includes:

1. Station switching in connection with passenger and freight traffic.

2. Switching in connection with the mechanical service.

3. Auxiliary work, such as disinfection, heating, reserve operations, etc.

4. Traveling empty in order to reach the work listed in paragraphs 1-3 above.

The above schematic breakdown of locomotive operation requires some explanation.

1. Empty locomotive runs are those in which one or more locomotives travels without a train. A locomotive traveling with one or two cars is also considered to be traveling empty if the number of axles on the attached cars does not exceed four. Runs of these cars and their contents are included in the operation of cars in group trains.

Locomotives hauling service trains, school trains, and workers' trains, which are constantly engaged in runs, are considered as hauling trains regardless of the number of axles pulled.

Empty runs in order to do switching work in stations or to pick up trains are counted among empty runs for service purposes. Empty runs for test purposes, on the other hand, or to take locomotives to and from repair or to regroup locomotives are counted as empty runs for mechanical purposes.

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2. Station switching includes car shunting performed by locomotives assigned especially to this work. This includes specifically shunting cars on station tracks, pushing trains which are departing from the station, hauling sand and gravel, removing trash, snow, etc, from the station area, servicing the car loading and unloading points, and servicing branch stations and mines without travel reports.

3. Train switching includes car shunting done by train locomotives, either pulling or pushing.

4. Supplemental and non-train locomotive operations are calculated according to the following principles: All types of switching (station, train, that for other services) are counted in locomotive-kilometers, taking one hour of work as equal to 5 locomotive-kilometers; reserve, i.e., locomotive down-time under steam with a full locomotive crew is counted in locomotive-kilometers, taking one hour of reserve as equal to 2 locomotive-kilometers.

5. Switching for other services refers to locomotive work performed in shunting cars onto shop, traction, and supply-depot tracks.

6. Branch-train operation counted as part of branch runs includes the switching work of locomotives sent, on the basis of a travel report, from the stations to which they are assigned to adjoining branch lines and mines.

7. Auxiliary work includes disinfection and scrubbing of freight cars, heating passenger cars, and similar work performed by special locomotives assigned to this work. Auxiliary work is counted in the switching work of that service for which it was done.

8. Reserve is the down-time of a locomotive under steam with a full crew if the down-time lasts, without interruption, more than one-half hour longer than the down-time allowed in the schedule, or there is more than one hour delay in switching work.

Utilization of Locomotive Operation

The modern large-capacity locomotive is a very expensive vehicle. The locomotive economy thus attaches great importance to the economical utilization of locomotives, i.e., to the performance of the maximum possible amount of work with the minimum number of locomotives. The locomotive economy strives in particular:

1. To increase daily locomotive runs by maximum utilization of locomotive time. This is done by increasing train speed; increasing the number of hours of useful locomotive work during the day by assigning two, three, and even four locomotive crews to operate one locomotive; by supplying the locomotive shops with sufficienttraction equipment; by proper organization of work in the locomotive shops; etc.

2. To increase the size and weight of trains; this makes effective use of the great power of modern locomotives by hauling more gross and net ton-kilometers with the same number of locomotive runs.

In this connection also statistics on locomotive operation have developed principally those units of measure and averages which define the utilization of locomotive time and the utilization of their power.

Utilization of Locomotive Time

The most important averages characterizing the utilization of locomotive time are the following:

1. Number of locomotive-hours of work per active locomotive per day. This is obtained by dividing the total time worked throughout the month by all locomotives in the directorate, in train and non-train work, on the territory of that directorate and others, by the number of working locomotives in the directorate, and then dividing that quotient by the number of calendar days in the month.

Locomotive hours are counted from the moment the locomotive appears at the control point when passing from line tracks to station tracks to the moment it passes through the control point from station tracks to line tracks, after completing its work.

2. Average daily run per functioning locomotive: For passenger trains this is found by dividing the monthly total of locomotive-kilometers in basic and supplementary passenger service by the number of calendar days in the report month, and then dividing the quotient obtained by the number of functioning locomotives in passenger trains. For freight trains, service, economic, and working trains, for station switching engines, and for locomotives in general in train and non-train service, this average is determined by dividing the pertinent daily number of locomotive-kilometers by the number of functioning locomotives working on a particular type of train or other work.

3. Average number of train-kilometers per locomotive-hour in train service. For passenger trains this is found by dividing the number of train-kilometers run by passenger trains under steam traction by the number of hours worked by locomotives on passenger trains. For freight, service, economic, and working trains this average is obtained, as above, by dividing the total of train-kilometers run by a particular type of train by the corresponding total of train-hours. For locomotives on all trains in general this average is obtained by adding the number of train-kilometers run by steam-driven passenger trains, the total number of train-kilometers in freight traffic, and the total runs by service, economic, and working trains and dividing the sum by the total number of locomotive-hours run on all types of trains.

4. Average run per functioning locomotive per hour. This quantity is found by dividing the monthly total of locomotive-kilometers run in trains and in non-train work by the locomotives of a

particular directorate in its own and neighboring okregs by the total number of hours worked by the number of functioning locomotives of the directorate.

The average locomotive speed calculated in this manner gives rather little information, since it includes all locomotives functioning in the okreg and thus embraces those engaged in train switching, station switching, in reserve, etc.

On the other hand a special calculation of the average speed attained by locomotives in train service is so devoid of significance that train speed is the proper quantity for evaluating traffic results. Thus statistics on operation of the PKP rolling stock do not properly involve the average speed of locomotives in train service.

Utilization of Locomotive Power

Quantities characterizing the utilization of locomotive power are:

1. Average number of gross ton-kilometers (in thousands) traveled per functioning locomotive in trains. In passenger, freight, service, economic, and working trains this value is found by dividing the gross ton-kilometers run during the report period by the locomotives of a particular directorate in each type of train by the number of locomotives functioning in these trains.

2. Average number of net ton-kilometers (in thousands) traveled per functioning locomotive in trains. In passenger, freight, service, economic, and working trains this quantity is obtained as above, i.e., by dividing the net ton-kilometers run during the report period by a given type of train by the number of locomotives functioning in these trains.

Productivity of Locomotives

The average productivity of locomotives is expressed in gross or net ton-kilometers run during the report period per locomotive, either of the total number of locomotives or of the number of able and disabled locomotives separately.

The index of locomotive productivity is structured similarly to the index characterizing the utilization of locomotive power, since the difference appears only in the units of reference. In determining locomotive productivity consideration is given only to the total number of locomotives or the number of able, or functioning, locomotives, while the characteristic of utilization of locomotive power refers only to locomotives functioning in trains.

5. Trains

Breakdown of Trains

The trains running on PKP lines are divided into three basic groups:

1. Trains in passenger service.
2. Trains in freight service.
3. Service, economic, and working trains.

Each of these basic groups is divided, for statistical purposes, into several types of trains. Trains in passenger service are divided into: fast (luxury, express, etc), long-distance passenger, local, suburban, mixed (passenger-freight), and special and tourist trains.

Trains in freight service are divided into: express and light small goods, fast freight, ordinary freight, group and branch freight, mixed (freight-passenger), and military and sanitary.

Mixed trains, which appear in both the above groups, belong to the category of passenger trains (as passenger-freight trains) if they are used principally for carrying passengers and carry more passenger than freight cars. Mixed trains used primarily for hauling freight and having more freight than passenger cars are included among freight trains as freight-passenger trains.

A special group is composed of trains used for railroad purpose, such as service, economic, and working trains. Service trains are divided into rescue, test and experimental, and inspection trains. Economic trains include those used for carrying freight solely for railroad purposes, while working trains are those sent out to load or unload material for railroad work.

Train Operation

1. Considered quantitatively.

A train is a distinct organizational-traffic unit. This unit performs the shipment of passengers and goods. For this reason it is the object of lively consideration by clients of the railroad who are interested in the number of trains in service, schedules, running time, train maintenance, etc.

A train is of still greater significance for railroad administration, being the actual executor of shipping work. This is associated with a number of important tasks concerning the shipping capacity of lines, the capacity and expansion of stations, the length of station track, etc. Then, independently of locomotive-operation statistics, special statistics of train operation become necessary, since they have their own background and their own purpose.

Train operation is described quantitatively in terms of runs completed. In view of the complex nature of this work a number of units of measure are used for runs in order to express either train-traffic work or shipping work. The derived numerical characteristics obtained from runs give the average size and weight of trains and the average load weight, and make it possible to evaluate the degree of utilization and the quality of operation of trains. The following are included in these runs:

(a) Train runs, expressed in train-kilometers. The number of train-kilometers itself gives little informationon the shipping work doneby trains because of the great differences in their size and weight, but it does make it possible, by comparing with other runs, to obtain important averages or mean values.

Statistics on rolling-stock operation calculates the number of train-kilometers run by adding the train-locomotive runs in passenger or freight service, since these quantities are identical with train runs. In this way runs, in train-kilometers, are obtained for passenger and freight trains of each type separately, as well as the total for the given type of traffic.

(b) Car runs, expressed in car-kilometers; and axle runs, expressed in axle-kilometers. In view of the considerable differences in car sizes, which are reflected in the number of axles on individual cars, axle-kilometers are more important for a quantitative description of train operation.

A comparison of car runs with train runs makes it possible to calculate the average number of axles in passenger and freight trains. The average number of axles on all cars and on passenger cars -- in passenger trains of each type separately and then the total in passenger service under steam traction -- is found by dividing the monthly run of the axles on all cars in the particular passenger trains under steam traction, or only the number of axles in the passenger cars in these trains, by the monthly run of the corresponding passenger trains under steam traction.

The average number of axles on all cars and on passenger cars -- in freight cars of each type separately, and the total for all types -- is found by dividing the monthly run of the axles on all cars in these trains in freight service, or the axles on the passenger cars in these same trains, by the monthly run of the corresponding trains in freight service.

The average number of axles describing the degree of utilization of train work with respect to train size is insufficient for a characterization of locomotive operation. This is because with the same number of car axles the weight of individual trains may differ depending on the average gross weight in tons per car axle, loaded and empty together. Data on train weight are calculated from the gross run weight in trains, which will be discussed below.

(c) Gross run weight in trains, expressed in gross ton-kilometers. This takes into account the actual weight of the cars making up the train (so-called tare weight), the weight of the passengers or goods shipped by the cars, and the weight of a cold locomotive. The load weight in normal-gauge passenger, baggage, and mail cars is taken as one ton per axle, regardless of the actual load weight or number of passengers. The weight of passengers transported in "towos" cars, of live cargo, and of objects accepted for shipment in freight cars according to the number of units are calculated according to certain average norms which have been established in the corresponding regulations.

(d) Net run load in trains, expressed in net ton-kilometers. This shows only the weight of loads carried (the so-called net), while the weight of loads carried in passenger, baggage, and mail cars, the weight of passengers in "towos" cars, and objects accepted for shipment in freight cars according to the number of units are calculated in the manner outlined in paragraph (c) above.

Both the net run load and the gross run weight in trains are given in thousands of ton-kilometers, in integral numbers.

During a journey the train engineer registers, in locomotive-operation reports, data on the weight and run of trains. The gross and net ton-kilometers given in these reports therefore show the actual distance covered.

Gross ton-kilometers are an expression of the shipping work performed by trains. Net ton-kilometers, derived from load runs in freight trains and calculated according to distances actually covered, and thus called also operational ton-kilometers, are the effect of the shipping work performed by trains, but are not yet useful (they represent a semifinished product). A useful effect is tariff ton-kilometers, which is the concern of shipping statistics, and is calculated from different statistical material according to tariff distance, which may be shorter than the distance actually covered. Net ton-kilometers, calculated for load run in passenger trains, represents the assumed weight of passengers and not their number; thus it cannot be compared with passenger-kilometers and its significance is doubtful.

Net run load and gross run weight in trains, when compared with train runs, permit the calculation of the average gross train weight and net load weight. In this process the average gross train weight and net load weight, in each type of passenger train separately and together, under steam traction, are found by dividing the gross weight in passenger trains under steam traction or the net weight of these trains by the run of passenger trains under steam traction during the same time period (usually during one month).

Average gross train weight and net load weight in freight trains of each type separately and together are obtained by dividing the gross weight or net load weight in these freight trains by the run of these freight trains during the same time period.

A comparison of the average gross weight of freight trains with the average net load weight provides a picture of the degree of utilization of the average gross weight of these trains for shipping freight.

2. Considered qualitatively.

As the quantitative description of the complex operation of trains requires the use of several types of runs, a characterization of the quality of this work uses a number of derived numerical characteristics. In addition to the derived values discussed above, the quality of train operation is characterized primarily by average train speed, expressed as the average run of trains during a single hour of travel (kilometers per hour). The index of average train speed, depending on whether one is obtaining technical or commercial speed, is obtained in the following manner.

(a) Average speed (kilometers per hour) of each type of passenger train, separately and together, in passenger service under steam traction, is obtained by dividing the total runs of these trains in passenger service under steam traction during the report period by the number of hours of actual travel of these trains (giving the tehhnical speed), or by the number of hours of actual travel plus train down-time (giving the commercial speed).

The average speed (kilometers per hour) of freight trains of each type, separately and together, is obtained by dividing the total runs of these trains in freight service during the report period by the number of hours of actual travel of these trains (giving the technical speed), or by the number of hours of actual travel plus train down-time (giving the commercial speed).

The number of hours of travel plus down-time embraces the time from the moment the train leaves the starting station to the moment it arrives in the end station, i.e., the station where the

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train is broken up, and includes down-time at intermediate or distribution stations, and at stations where the locomotive or the crew is changed. Total travel time plus down-time, and the number of hours spent in actual travel, are expressed in train-hours, which are the units recorded by statistical registration.

(b) Operation of trains during a single hour is given by the product of the average size or average weight per train and the average commercial speed per train.

Depending on the units in which the weight or size of the train is expressed (tons, cars, or axles), the hourly operation of different types of trains will be expressed by the number of gross ton-kilometers, train kilometers, or axle-kilometers. The operation of freight trains can, in addition, be expressed in net ton-kilometers.

Some railroads also characterize the quality of train operation by quantities such as the amount of delay of passenger trains, expressed in minutes per 100 train-kilometers in passenger traffic; the relationship of real commercial speed of trains to the commercial speed envisioned in the schedule; the relationship between commercial train speed and technical speed (the so-called coefficient of speed); etc.

6. Statistical Lists

Statistical lists, dealing with the number of railroad rolling stock, should include tables showing the following for each type of rolling stock:

1. Inventory number and the corresponding averages, such as the total number of able rolling-stock units, the number of functioning units, etc, broken down to home okreg directorates.

2. The composition of self-owned rolling stock, broken down to characteristic structural features such as load capacity, carrying capacity, number of positions, tare weight, etc.

Statistical lists on the operation of individual types of railroad rolling stock should, in these tables, contain data, broken down into okreg directorates, on the so-called operation of freight cars; train runs, expressed in train-kilometers and train-hours; locomotive runs in train service and in non-train work, expressed in locomotive-kilometers and locomotive-hours; car runs, expressed in car-kilometers and axle-kilometers; runs of other rolling-stock units, expressed in corresponding units of measure; and runs of gross train weight and net load weight, expressed in ton-kilometers.

The tables describing the operation of rolling stock should include the corresponding derived numerical characteristics given above and characterize the work completed both quantitatively and qualitatively.

The statistical lists representing annual periods should show the composition of rolling stock both in absolute figures and in structural indexes. The statistical lists representing longer periods should use dynamic indexes to show changes in the size and composition of rolling stock and the amount of work accomplished.

In view of the great number and variety of statistical lists which can be included under this heading the above remarks are of only a general nature. The types and system of statistical lists which should be set up should be decided primarily by the requirements of planning and exploitation.

C. STATISTICS ON THE NUMBER AND OPERATION OF AUTOMOTIVE ROLLING STOCK

1. Statistical Material

The basic source document for registering rolling-stock operation is the "road chart", which the vehicle driver receives from the garage before departure and which he uses for making his records.

The purpose of the road chart is to give a complete picture of the operation of the vehicle from the moment of departure from the garage to the moment of return. Data from the road chart are transferred daily to the monthly "operational chart". Separate operational charts are kept for each vehicle on which records are kept by the particular automotive organizational unit, regardless of the technical condition or use of the vehicle. At the end of the month, on the basis of the operational charts, data are worked up relating to the number and operation of the rolling stock, utilization of fuel, completion of runs and shipments, etc.

2. Number of Rolling Stock, and Its Characteristics

The number and composition of automotive rolling stock as of a given date are presented according to the technical properties of the rolling stock, such as buses and passenger trailers, passenger cars, for passenger rolling stock; trucks, tractors, attachments, trailers, and tank trucks for freight rolling stock; and shops (hoists), sanitary trucks, etc, for special rolling stock.

Figures for buses and passenger trailers are given in terms of the number of places for passengers, while those for passenger cars and truck trailers are given in terms of load capacity of the vehicle, in tons. All these vehicles are divided according to accepted criteria into statistical groups which are used to characterize the composition of rolling stock according to capacity.

The number of automotive rolling stock for a given time period and the characteristics of its condition in this period are expressed in car-days.

The most common unit of measure is the recorded car-day, denoting the calendar days, including holidays, when a vehicle was included in the records of the given automotive transport unit, regardless of the actual location of the vehicle on the given day (such as in cases of lending or leasing out, etc).

Recorded car-days are divided into the following groups:

1. Operational car-days, representing each calendar day during which the vehicle works, independently of the time spent outside the garage.

2. Car-days in capital, medium, and current repair.

3. Car-days awaiting repair; representing each calendar day of trouble on a vehicle such that it could not be operated.

4. Car-days of down-time on able vehicles, representing each calendar day during which a vehicle could not be used because of lack of work, bad roads, or for other reasons.

The coefficient of technical preparedness of the rolling stock characterizes the opportunities for utilizing the given automotive rolling stock during the report period. It expresses the relationship between the number of technically repaired vehicles available for shipping work and the number kept on the records. This coefficient is calculated by dividing the total car-days in operation and the car-days of down-time on able vehicles by the number of car-days in the records for the given time period.

The coefficient of utilization of rolling stock depicts the actual utilization of rolling stock during the report period. This is calculated by dividing car-days in operation for the given time period by the corresponding number of car-days on the records.

Obviously the value of this coefficient will, in the most favorable case, equal the value of the coefficient of technical preparedness of the rolling stock, but usually it will be lower. This is because when the denominators of the two coefficients are equal the numerator of the coefficient of rolling-stock utilization will usually be smaller, since it takes into account only car-days in operation.

3. Utilization of Load Capacity of Rolling Stock

The total load capacity in respect to weight, or the number of "car-tons" on a certain day, is calculated by multiplying the number of trucks with the same capacity which are on the records on the given day by the nominal load capacity per vehicle of the given group, and adding up the products obtained for all these groups of vehicles.

The total load capacity in respect to places, or the number of "car-places" in the bus rolling stock on a certain day, is calculated by multiplying the number of buses and passenger trailers with the same capacity which are on the records on the given day by the nominal capacity per vehicle of the given group, and adding up the products obtained for all these groups of vehicles.

Car-ton-days and car-place-days. Along with daily changes in the number and composition of rolling stock, changes occur in the total load capacity of truck and bus rolling stock. In order to determine the mean weight capacity or the mean place capacity during a given time period, and in order to determine the mean daily productivity of the rolling stock per unit of load capacity, special units of measure are derived which give this quantity in terms of time. These are:

1. Car-ton-days in records. This is calculated by multiplying the car-days of all trucks with the same load capacity which are on the records during the given time period by the nominal load capacity per vehicle of the given group, and adding up the products obtained for the individual groups of vehicles.

2. Car-ton-days in operation. This is calculated by multiplying the car-days of all trucks with the same load capacity which are in operation during the given time period (so-called car-days in operation) by the nominal load capacity per vehicle of the

given group, and adding up the products obtained for the individual groups of vehicles.

3. Car-place-days in records. This is calculated by multiplying the car-days of all buses and passenger trailers with the same capacity which are on the records during the given time period by the number of places per vehicle in the given group, and adding up the products obtained for the individual groups of vehicles.

4. Car-place-days in operation. This is calculated by multiplying the car-days of all buses and passenger trailers with the same capacity which are in operation during the given time period (so-called car-days in operation) by the number of places per vehicle in the given group, and adding up the products obtained for the individual groups of vehicles.

5. The car-day and car-place-day units make it possible to derive the mean load capacity of the truck pool or the mean capacity of the bus pool for a given time period:

(a) The mean load capacity of the truck pool on the records (i.e., the mean number of car-tons on the records) for a given time period is calculated by dividing the number of car-ton-days on the records for the given time period by the number of car-days on the records.

(b) The mean load capacity of the truck pool in operation is calculated by dividing the number of car-ton-days in operation for the given time period by the number of car-days in operation.

(c) The mean capacity of the passenger-vehicle pool on the records (i.e., the mean number of car-places on the records) for a given time period is calculated by dividing the number of car-place-days on the records for the given time period by the number of car-days on the records.

(d) The mean capacity of the passenger-vehicle pool in operation over a given time period is calculated by dividing the number of car-place-days in operation for the given time period by the number of car-days in operation.

6. The coefficient of utilization of load capacity in its so-called dynamic form is used to show the degree of utilization of the load capacity of the truck pool. The value of the coefficient is calculated by dividing the number of ton-kilometers actually run during a given time period by the product of the mean load capacity of the truck pool in operation and the number of car-kilometers run with loads during the same time period.

This product (the mean load capacity of the truck pool in operation times the number of car-kilometers run with loads) represents the so-called available shipping services. This coefficient of utilization of load capacity is the relation between the real run traveled by loads (i.e., the effect of shipping operations) and the run of the mean load capacity of the vehicle pool in operation, the latter being the possible effect if the load capacity of all trucks in operation when run with loads was utilized 100 percent.

The volume of this coefficient is usually given as a percent of capacity utilized.

7. Coefficient of supplemental utilization. This is calculated by dividing the number of passenger-kilometers actually run during a given time period by the product of the mean capacity of the bus pool in operation and the number of productive car-kilometers run during this time period (i.e., the sum of kilometers run by the bus pool in conveying passengers). This coefficient is also given in percents.

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4. Runs of Rolling Stock and Their Utilization

The total run of a vehicle is the distance covered by the vehicle using its own engine in performing all its journeys, i.e., both productive and nonproductive journeys, with and withouttrailers. The total run of a vehicle is expressed as the "total car-kilometers". The following types of runs are distinguished among vehicle runs: (for trucks):

1. Loaded car-kilometers. This is the total number of kilometers run by a vehicle while loaded; it denotes theuseful work of a vehicle.

2. Empty car-kilometers. This is the runs of the vehicle traveled without loads, between unloading and loading points.

3. Zero car-kilometers. This consists of the vehicle runs from the garage to the first loading point, and from the last unloading point back to the garage.

For buses these types of runs are distinguished:

1. Productive car-kilometers. This is the total number of kilometers run by a bus in carrying passengers.

2. Zero car-kilometers. This consists of bus runs from the garage to the point where productive runs begin, and from the point where productive runs end back to the garage.

The coefficient of utilization of truck runs is used to evaluate the manner in which the total runs of the truck pool were utilized in loaded runs. This coefficient is calculated by dividing the number of loaded car-kilometers run during a given time period by the total number of car-kilometers run during the same time period (the "total car-kilometers") by the truck pool.

The coefficient of utilization of bus runs depicts the degree of utilization of total runs of the passenger-vehicle pool for productive runs. The coefficient is calculated by dividing the productive car-kilometers run during a given time period by the total number of car-kilometers (the "total car-kilometers") run by the bus pool during this same time period.

5. Utilization of Work Time by Rolling Stock

The number of hours charged is calculated according to the road chart as the difference between the time of departure of the vehicle from the garage and the time of its return.

Travel hours are calculated according to the road chart as the difference between the number of hours charged and the amount of time consumed by the vehicle for all stops during the period of hours charged.

The coefficient of utilization of work time by vehicles is calculated by dividing the number of travel hours during a report period by the number of hours charged during the same period.

6. Average Productivity of Automotive Rolling Stock

The productivity of automotive rolling stock is the relationship between shipping accomplished by the particular vehicle pool and the time consumed in this shipping. Average productivity is measured in terms of the number of ton-kilometers or passenger-kilometers per vehicle during a given time period per unit capacity of the rolling stock. The following coefficients are used to express the productivity of the truck pool:

1. Coefficient of average productivity of the truck pool per vehicle. This coefficient gives the number of ton-kilometers run by the truck pool during a given time period per truck on the records or in operation.

This coefficient can be used only for a truck pool composed of trucks with the same capacity. When this coefficient is used for comparative purposes the radius of vehicle operation should be taken into account.

If the truck pool is made up of trucks with different capacities, the average productivity of the pool should be expressed in terms of coefficients 2., 3., and 4. below.

2. Coefficient of average productivity of the truck pool per mean car-ton on the records. This is calculated by dividing the number of ton-kilometers run during a given time period by the mean load capacity of the truck pool on the records during the same time period.

3. Coefficient of average productivity of the truck pool per mean car-ton in operation. This coefficient is calculated by dividing the number of ton-kilometers run during a given time period by the mean load capacity of the truck pool in operation during the same time period.

4. Coefficient of mean daily productivity of the truck pool. This coefficient shows the average number of ton-kilometers run daily per ton of capacity. This coefficient is calculated by dividing the number of ton-kilometers run during a given time period by the corresponding number of car-ton-days on the records or in operation.

In order to obtain comparative data for trucks operating with different work days (wherein the work day refers to the average number of hours of work charged per vehicle per day) the coefficient of mean daily productivity is calculated not per car-ton-day but per car-ton-hour.

The following coefficients are used for the passenger pool:

1. Coefficient of average productivity of the passenger pool per mean car-month on the records. This coefficient is calculated by dividing the number of passenger-kilometers run during a given time period by the mean capacity of the passenger pool on the records, i.e., by the mean number of car-places on the records.

2. Coefficient of average productivity of the passenger pool per mean car-month in operation. This coefficient is calculated by dividing the number of passenger-kilometers run during a given time period by the mean capacity of the passenger pool in operation, i.e., by the mean number of car-places in operation.

D. STATISTICS ON THE NUMBER AND OPERATION OF FLOATING STOCK IN INLAND SHIPPING

1. General Remarks

Statistics on the number and operation of floating stock in inland shipping has been forced to adopt units of measure and derived numerical characteristics which differ in a number of respects from the units of measure and numerical characteristics used by the other means of transportation. The resulting system is not so transparent nor does it have the same detailed interrelationship of individual elements in a closed unit as the other means of transportation. This state of affairs is the result of peculiar differences between inland shipping and other means of transportation, as the following paragraphs show.

1. With respect to administration, inland shipping does not show a need for such far-reaching centralization as does, for instance, railroad transportation.

2. With respect to the technical features of floating stock, the units used by inland shipping require different means of locomotion, ranging from those with their own mechanical drive to those with no power source of their own.

Unlike other means of transportation the tonnage and machine power of shipping units, even those belonging to the same type, show such variation that the use for these vessels of units of measure structured like those in other means of transportation would not be sufficient to describe the number or operation of the inland fleet.

3. With respect to operational features, inland shipping is seasonal and cyclic, while the duration of the navigation season differs in different river systems.

The peculiar features of traffic and shipping up- and downstream, the dependence of traffic and the degree of utilization of capacity on water level, and the great importance of shore operations create for inland shipping operational conditions which cannot be compared to those of other means of transportation.

2. Number and Utilization of Floating Stock

The number of floating stock in inland shipping is given either as of a certain date or as of a certain time period.

In the former case the floating stock is given in the records grouped according to technical features, such as units with their own mechanical drive (tugboats, passenger ships, cargo-passenger ships, dry-cargo ships, tank ships, some barges) and those without their own mechanical drive (dry-cargo barges, tank-barges, etc).

The number of floating stock for a particular time period includes the following data:

1. The number of ship units broken down according to type of operation and utilization.

2. (a) For barges: the number of barge-days in operation and not in operation included in the records for this time period.

(b) For units with their own mechanical drive: the number of power-days (Horsepower-days) included in the records for the given time period.

(c) For passenger-cargo and cargo ships and barges: the number of tonnage-days in operation and not in operation included in the records for the given time period.

Barge-days, horsepower-days, and tonnage-days in operation are divided into the time during which the units are in motion and stopped. Further breakdown may be employed depending on operational conditions.

The units which are "not in operation" include units leased, temporarily out of service, under repair, and those units inactivated, awaiting repair, and standing at anchor or moored for non-operational purposes.

The complex units of measure barge-days, power-days, and tonnage-days are used as follows:

Barge-days is the product of the number of barges and the number of days during which the barges were kept on the records. Barge-days denotes the time during which barges were in a given state (in operation, not in operation) or being used in various ways (in shipping, being loaded, unloaded, transloaded, for storage purposes, etc).

Power-days (horsepower-days), is the product of the indicated power of the main machinery in horsepower multiplied by the number of days during which the floating-stock unit was kept on the records of the number of units with their own mechanical drive.

Tonnage-days of measured load capacity is the product of the measured load capacity of a floating-stock unit (except tugboats and passenger ships), expressed in tons, multiplied by the number of days during which the unit was kept on the records.

Tonnage-days in loaded condition is the product of the real load capacity of floating-stock units (except tugboats and passenger ships), expressed in tons, in connection with their permissible submersion in a loaded state under the given sailing conditions, multiplied by the number of days during which the floating-stock unit was kept on the records of floating-stock units.

Example. A barge which is on the records during the month of August (31 days) and has a measured load capacity of 600 tons represents 600 x 31, or 18,600 tonnage-days. The same barge, however, may represent only 480 x 31, or 14,880 tonnage-days when loaded if the permissible submersion of the barge with the particular water level during August allows only 480 tons of cargo (80 percent utilization of the measured load capacity).

The unit of measure "loaded tonnage-days" makes possible, under the shipping conditions prevailing on Poland's waterways, realistic planning for the full utilization of floating stock with respect to time, in terms of actual load capacity. It also gives an accurate basis for evaluating the operational results achieved in comparison with realistic possibilities, expressed in loaded tonnage-days.

3. Floating-Stock Runs

The runs of floating-stock units are expressed in complex units of measure such as barge-kilometers, ship-kilometers, etc. These units of measure give the formal aspect of runs since they do not take into account the fact that individual floating-stock units differ considerably in load capacity and in mechanical power.

The tonnage-kilometer and the loaded tonnage-kilometer are useful for describing the run of a floating-stock unit in terms of its load capacity. Tonnage-kilometers are calculated by multiplying the measured load capacity per floating-stock unit, in tons, by the distance traveled, in kilometers. Loaded tonnage-kilometers are calculated by multiplying the real load capacity per floating-stock unit (in terms of the permissible submersion when loaded under specific sailing conditions), in tons, by the distance traveled, in kilometers.

The concept of the run per floating-stock unit, in tonnage-kilometers, must not be confused with the concept of load run, expressed in ton-kilometers.

The run of a floating-stock unit using its own power, in terms of the power of its main machinery, is expressed in power-kilometers (horsepower-kilometers). In this case the run is calculated by multiplying the indicated power of the machinery, in horsepower, by the distance traveled, in kilometers.

4. Speed of Floating-Stock Units

The speed of floating-stock units refers to the relationship between the distance covered by a loaded unit and the time consumed for this purpose. The speed of a floating-stock unit is a mean value calculated separately for travel up- and downstream, as follows:

1. For a single journey:

(a) For cargo-passenger ships, cargo ships, and barges with and without their own source of power, loaded tonnage-kilometers are divided by the loaded tonnage-days consumed in the journey.

(b) For tugboats the power-kilometers (horsepower-kilometers) traveled in hauling are divided by the corresponding power-days (horsepower-days) engaged in hauling loaded barges.

2. For the sailing season:

(a) For cargo-passenger ships, cargo ships, and barges with and without their own source of power, the totals of all loaded tonnage-kilometers traveled during the sailing season on trips up- and downstream are divided by the total loaded tonnage-days consumed by these trips.

(b) For tugboats the totals of all power-kilometers (horsepower-kilometers) traveled during the sailing season in hauling up- and downstream are divided by the total of the corresponding number of power-days (horsepower-days) consumed in hauling loaded barges.

The speed of a floating-stock unit is thus determined as a mean, by calculating the mean speed per ton of load capacity or per horsepower. Only the runs of loaded ships and barges, and of tugboats hauling loaded barges, are given.

The quantities determined in this fashion represent the number of kilometers run per day and are called the mean technical speed, which in this case also includes down-time.

5. Utilization of Load Capacity and Mechanical Power

The utilization of load capacity of cargo ships and barges is the relationship between the number of ton-kilometers actually traveled on the particular journeys and the number of possible ton-kilometers if on these journeys the ship or barge had been utilized to the maximum degree possible under existing shipping conditions (so-called available ton-kilometers).

The coefficient of utilization of load capacity, expressed in percents, is calculated by dividing the number of ton-kilometers traveled during the given time period by the corresponding loaded tonnage-kilometers and multiplying the product by 100.

The coefficient of mechanical power of a tugboat is the relationship between the effect of the tugboat's shipping operations (in ton-kilometers) and the runs made by the tugboat, in terms of its mechanical power. A similar coefficient, which expresses the number of tons hauled per horsepower, is calculated by dividing the number of ton-kilometers traveled by the tugboat by the corresponding power-kilometers (horsepower-kilometers) of the tugboat.

6. Productivity of Floating-Stock Units

The productivity of floating-stock units means the relationship between the effect of the work performed by a unit and the time consumed in performing this work.

The coefficient of productivity per floating-stock unit is calculated for cargo ships and barges by dividing the number of ton-kilometers traveled by the unit during a given time period by the number of tonnage-days in operation or the number of loaded tonnage-days. The coefficient shows the mean number of ton-kilometers per ton of load capacity of the given floating-stock unit per day of operation.

For tugboats the coefficient of productivity is calculated by dividing the number of ton-kilometers traveled by the tugboat during a given time period by the corresponding number of power-days (horsepower-days) of the tugboat in operation. The coefficient expresses the mean number of ton-kilometers per horsepower per day of operation.

CHAPTER IV. STATISTICS ON EMPLOYMENT AND WAGES

A. INTRODUCTORY REMARKS

The tasks of building socialism and developing the national economy, as established in the Six-Year Plan for 1950-1955, require enormous expenditures. The principal source for meeting these expenditures is increased labor productivity the pace of which, under the conditions of socialist planned economy, is to be raised to a maximum. In the light of the enormous goals of the Six-Year Plan it becomes reasonable to base the new financial organization and the financial system of the state enterprises on the principles of khozraschet; it also becomes clear how important it is to develop the maximum accumulation, planned and in excess of the plan.

The state public transportation enterprises employ around 400,000 people. The wages and social benefits of this vast army of workers consumes more than 50 percent of all operational expenditures of the transportation enterprises. When one realizes that expenditures for the wages of a large proportion of the employees belong in the category of expenses independent or almost independent of the volume of shipping, then it is clear why matters such as the size of enterprise employment, work time and its utilization, increases in labor productivity, and establishing wages on the proper level all begin to occupy important positions in the problems connected with reducing operational expenses, with reducing unit costs, and with increasing the rate of accumulation of the transportation enterprises.

Quite apart from this the level of employment and of wages paid to such a large part of the national economy is of tremendous social significance.

Thus the most important task of reporting and statistics on employment and wages is to collect and work up material which, when compared with data on plan fulfillment in the other branches of enterprise management, will make it possible to determine the degree and quality of fulfillment of planned goals in labor and wages, and help in the analysis of causes of discrepancies discovered. Such causes may be shortcomings in the organization of technological processes, in the system of norming work, in wage payment, etc.

Systematic reporting and analysis of statistical material are, therefore, of great practical importance in the field of employment and wages.

B. COMPOSITION AND SIZE OF EMPLOYMENT

1. Breakdown of Employment by Groups

The basic activity of transportation enterprises consists in shipping passengers and goods. The transportation enterprises perform, in addition, a number of other important functions, the purpose of which is to service and develop basic operational activity.

In this connection the workers employed in a transportation enterprise are to be divided into the following groups:

1. The operational group.
2. The non-operational group.
3. The investment group.
4. The capital-repairs group.

The operational group contains workers whose work is connected with the basic activity of the enterprise, and whose wages are chargeable to operational costs. They include:

1. Operational workers, i.e., those connected directly with the production of shipping services and who service operational machinery and equipment.

2. Engineering-technical workers, who perform functions requiring engineering or technical skills. This group also includes planners and economists.

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3. Administrative-office workers, such as directors, cadre-division workers, financial, administrative, economic, supplies and sales workers, clerks, telephone operators, etc.

4. Economic workers, such as waged workers, drivers, messengers, stokers, drivers of automotive vehicles, etc.

5. Armed protective workers, fire guards, etc.

6. Apprentices, regardless of age, engaged in individual or group study and paid according to the apprentice pay scale.

The non-operational group includes:

1. Health-service workers.

2. Workers employed in the administration of residence houses.

3. Agricultural workers.

4. Dormitory workers.

5. Workers employed in watching nonfunctioning installations belonging to functioning installations.

6. Workers employed in social-welfare installations.

The investment group and the capital-repairs group include workers performing investment and capital repairs by the economic method, and workers paid from investment funds or capital-repair funds.

The above breakdown is essentially equivalent to grouping workers according to the sources from which their wages are financed. Individual types of inland transportation operate with the aid of a large number of organizational chambers located throughout the country according to the line principle. This explains the need for breaking down each type of transportation into okreg enterprises or other supervisory regional units to coordinate the activities of their subordinate regional units.

The transportation enterprises have a very complex structure, which is the result of entrusting functions of a given type to individual regional units. The regional units which are called upon to perform these service functions are organized directly into so-called "services", regardless of their location. The managing organs in these services are subordinated functionally to the central organ above them. This type of organization is peculiar to transportation, particularly to the railroads.

In this connection the workers in any given type of transportation belong to various okreg enterprises and simultaneously to various services, such as the traffic service, the commercial services, etc.

The service functions of any given "service" involve a number of definite tasks whose performance is entrusted to separate work groups. The work of these groups is given in terms of appropriate units of measure.

Within the confines of a given work group a worker may be employed at various jobs depending on his training and skills.

Such a complex structure of employment makes the job of employment statistics difficult, particularly when the grouping is to take account of still other features, such as training, service examinations taken, sex, age, the nature of the service position, awards received, etc.

Special statistical investigations may, in addition, break down employees according to "stages". This grouping uses the following features:

1. Total stage of work (time spent on plant work);

2. Stage of work in transportation or in the given enterprise;

3. Stage of work in the given plant or at the given place of work when the same functions are being performed.

4. Stage of work in the given installation.

The desired features are selected in concrete cases depending on the purposes of the investigation.

2. Registration of the Number of Employees

An employment report is submitted on the workers kept on the personnel records in the given installation and receiving wages from the installation. The employment report should include, above all, the following groups of workers.

1. Workers who actually have begun work.

2. Workers on service delegations, on vacations, sick leave, maternity leave, etc.

3. Workers who, despite their obligation to appear for work, have for various reasons not come, because of illness, state obligations, justifiable personal reasons, laziness, etc.

4. Workers called up for temporary military duty, if they retain their wage rights.

5. Workers working outside the given installation or sent for courses, etc, provided they continue to be paidby their installation.

The following, on the other hand, are not included in employment reports:

1. Workers sent to work in other installations and receiving their wages there.

2. Students at higher educational instatutions and apprentices at plant schools who are receiving their practical experience in the given installation.

3. Workers engaged for short-term work projects outside the scope of basic installation activity, such as small repairs to electrical equipment, etc.

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The number of workers shown in employment reports varies more or less on individual days of the report period for numerous reasons. This makes it necessary to make a so-called "employment average", i.e., the average number of workers appearing in the employment report during the report period.

The employment average during the report period (such as during a month) is calculated by adding up the number of workers appearing in the employment report on individual days of the report period and dividing the total by the number of work days during the report period. In regard to workers employed in "turnus" work the employment average is obtained in terms of calendar days of the report period, i.e., including holidays.

C. EMPLOYEE TURNOVER AND FLUIDITY OF EMPLOYMENT

Employee turnover is the change in the number of workers resulting from the hiring of new ones combined with the departure of former workers, regardlessof the reasons for which they leave.

Data on employee turnover in a given month are obtained under the following headings of the work-report forms:

1. Number according to report as of the first day of the report month.

2. Newly hired.

3. Released from work.

4. Number according to report as of the first day of the following month.

The total number of workers as of the beginning of the report month, plus the number of workers hired, minus the number of workers released from work, should equal the number of workers as of the first day of the month following the report month (headings 1 plus 2 minus 3 = 4).

The number of workers hired and released should include only the number of workers hired plus those released to work outside the given installation.

The intensity of turnover is expressed by a relative figure which represents the turnover of employees calculated according to the following formula:

$$J = \frac{S_o + P}{Z_p}$$

where J = the index of employee turnover,

S_o = the number of employees as of the first day of the report month (heading 1),

P = the number of workers hired during the report month (heading 2), and

Z_p = the average employment during the report month.

The number of workers released is expressed only indirectly in this formula, in the average employment during the report month.

Employee turnover shows the instability of the worker corps as a result of hiring of new workers and release of old workers, without discussion of the causes of these hirings and firings. Such causes may be organizational changes, increases or decreases in the volume of work in the particular installation, etc.

Negative factors which disturb and disorganize the normal course of the productive shipping process are only those cases in which workers left work for reasons not connected with installation activities. Such reasons include release from work on the workers's own request, for disturbing work discipline, as a result of incapacity for work, etc. The variation in the composition of personnel which is the result of this type of release from work and the new hirings which result is defined as the <u>fluidity of employment</u>, in contrast to the turnover of employees discussed above.

Employment fluidity may be determined only on the basis of a careful investigation of the causes of hirings and firings of workers. In cases in which detailed data are lacking employment fluidity may be calculated (if great efforts are exerted in favor of accuracy) on the basis of general data on the number of workers hired and fired during the report period. The so-called index of employment fluidity is an expression of the percentage relationship of the smaller of these figures (workers hired and fired) to the average employment during the report month.

The above method of calculating the index of employment fluidity is based on the fact that only the smaller figure (either those hired or those released) should be considered as the factor which in the given case determines the fluidity of employment, and that the factors making the other figure not equal but larger should be ascribed to causes associated with the planned activity of the enterprise.

D. WORK TIME AND ITS UTILIZATION

1. Work Time

Work time is expressed in work-days or work-hours worked. The account-day is also used.

A work-day is each day the worker comes to work including days on which he leaves work, regardless of the number of hours he worked on those days. The number of work-days worked, in this sense, includes:

1. Work-days of workers who appeared for work in the installation on a given work-day and worked a full or partial day.

2. Work-days worked on holidays in the form of overtime work.

3. Work-days during which service delegations worked on installation matters.

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4. Work-days of workers who, in connection with ddays during the month in their basic work, were transferred to other work.

Work-days are not sufficient to determine the degree to which work time was utilized, since they do not show time losses which may occur during the work-day.

Work-hours represent the number of hours during which actual work lasted. Hours of delay are included in work-days, but they should not be included in work-hours. Overtime hours worked should be included in work-hours in direct numerical representation, and not according to the excess wages paid for these hours worked.

Work-hours processed in this way are a complete unit of measure, used to determine labor productivity, not showing distortions.

Delay time is that time during which a worker did not work at all on his basic work (as a result of delays) and was not used for other work. Delays may be caused by shortages of materials or electric power, breakdowns, etc. Delays lasting an entire day are expressed in work-days, while shorter delays are given in work-hours.

Overtime refers to the number of hours worked in additionto the legal work-time norm, and the number of hours worked on days which, according to the established work plan, should be days off from work.

The normal length of the work day in Poland is determined by the law on work time in industry and commerce. According to this law the work day may be no longer than 8 hours per day and cannot exceed 46 hours per week. Work time equals the number of hours during which the worker is obliged to remain at his work or elsewheee on orders of the work director, on the basis of his work contract.

The work time of persons in installations under individual ministries may, in the spirit of the law mentioned above, be adjusted by special order of the particular minister after listening to the opinions of the plant unions, leading to the substitution of equivalent norms for the norms established in the law.

Transportation has required this type of adjustment of work time because of the duration of the shipping process, the variety of work performed in transportation, and the fluctuations in the amount of this work needed even over brief time spans.

The order of the Minister of Railroads of 10 June 1920 adjusted the work time of PKP employees by introducing so-called labor coefficients, established for each place of work and service post. The labor coefficients take into account the particular working conditions in railroad transportation, in which periods of active work are interspersed with periods of waiting for work. The service time during which the worker actively performs productive operations without interruption equals 46 hours per week, and this work has a coefficient of one. Service during which a worker is in reserve, i.e., without work at his place of work, waiting for work, is given a coefficient of one-third. The time spent in this service should thus be divided by 3 in order to obtain the number of hours worked in terms of active work. Depending on the relationship between active work time and time spent waiting for work other coefficients of work and waiting time were established. Table 7 gives a list of the binding labor coefficients together with the corresponding time spent in service in hours per day, week, and month, assuming that work during the particular month was continuous, i.e., that work was done on Sundays and holidays as well.

Table 7

Labor Coeffi- cient	Relationship of Active Work Time to Time Spent Waiting for Work	Service Time in Hours per Day	Week	Month-
1	Uninterrupted active work	6:40	46	200
5/6	3/4 to 1/4	8	56	240
2/3	1/2 to 1/2	10	70	300
1/2	14 to 3/4	13	91	390
1/3	Ready for work		(138)	

It should be noted that in determining weekly service one must use a number of hours divisible by 7, which causes certain small deviations from the figure obtained by strict calculation.

An order of the Minister of Labor and Social Welfare adjusted the work time of inland-shipping workers, setting it at 46 houss wekly. If technical conditions require, this norm can be replaced by an equivalent norm equal to 1,196 hours of work per six-month period, or 46 hours average per week, while the work time on individual days cannot exceed 12 hours per day.

The order of the Minister of Labor and Social Welfare adjusted the work time of persons employed in the shipping industry, engineers, truck drivers, conductors, etc.

The legal work-time norms for these people may be replaced by other norms provided work time does not exceed 10 hours per day or 598 hours in a 13-week period. Persons in the group mentioned above who are engaged in necessary work preceding the departure of an automotive vehicle from its place of rest or following the return of such a vehicle to its place of rest may be employed for a maximum of two hours daily in addition to the above norms.

The actual length of the work day during a report period is expressed by the average real work time in hours per day, i.e., including overtime hours. This is calculated by dividing the total number of work-hours actually worked during the time period by the number of actual work-days during this same period.

The index of utilization of work time is a relative figure, giving the relationship between the number of work-days actually worked and the total number of work-days in the given time period. The total number of work-days in a given time period is calculated by multiplying the proper employment average by the number of work-days during the given report period.

2. Work Discipline

During a given report period an installation has available a certain number of work-days which is the product of the average employment and the number of calendar days during the report period minus the number of work-days not utilized in the installation as a result of absenteeism. Absenteeism, which is always expressed in work-days, thus characterizes the time not utilized in the given installation.

Work statistics which registers days of absenteeism uses the following classification of the causes of absenteeism:

1. Vacations.
2. Maternity leaves.
3. Sickness.
4. Absenteeism based on other binding legal regulations.
5. Absenteeism with the approval of the administration.
6. Arbitrary absenteeism.
7. Holidays.

The number of work-days on unpaid leave is added to absenteeism with the approval of the administration. The number of days off from work for the period of a disease is included in the number of days of holiday and not in the number of days of absenteeism because of sickness.

With the exception of arbitrary absenteeism all the above cases of absenteeism result from causes recognized in the binding legal regulations.

Labor discipline is directed toward avoiding the disorganization of work which results from arbitrary absenteeism, from tardiness, and from frequent departure from work without good reason.

According to Article 1 of the law of 19 April 1950, concerning provisions for socialist labor discipline, every physical and intellectual worker must be held responsible for disturbances to labor discipline resulting from unapproved absenteeism.

3. Norming

Data on absenteeism for various reasons do little to illuminate the problem of how work time is used during the working day. In order to determine the method of utilizing the working day data must be available on the amount of time devoted to:

1. Productive (active) work,
2. Nonproductive work, and
3. Delays (waiting for work).

Determinations of this type are, to be sure, among the tasks of labor norming, but their outcome is a matter of lively interest to statistics as well. The data obtained is of great value for the organization of technological production processes and of labor, which is in turn one of the decisive factors in the rate of increase of labor productivity.

4. Labor Productivity

Labor productivity denotes the efficient utilization of labor, and is expressed as the amount of production of a given quality turned out in a unit work-time or, conversely, as the amount of time consumed per unit production. Labor productivity thus boils down to:

1. The relation between production and the labor directly consumed in the given branch of production, so-called "live" work.

2. The relation between production and the total labor consumed for this purpose, i.e., both "live" work and materialized labor, which is contained in the means of production consumed in the production process (fuel, materials, tools, etc).

The labor competition movement which is developing in Poland, based on the Soviet example of the Stakhanovite, Luninov, Krivonosov, and many other movements, is directed toward obtaining better productive results with simultaneous savings in the consumption of materials, fuel, etc. Herein the unit of reference for labor productivity is not live work alone. At the same time the majority of indexes of labor productivity discussed in this section used only live work as their unit of reference.

The proper solution of a large number of economic problems in transportation, and particularly the need for maximum accumulation, requires a large and systematic increase in labor productivity, i.e., increases year by year.

Since labor costs in transportation constitute more than 50 percent of operational expenses, increases in labor productivity represent one of the main factors which can reduce unit production costs.

Increases in labor productivity will also make it possible to carry a larger number of shipments with the same or only slightly larger number of workers and rolling stock. Thus the income of the transportation enterprises will increase more rapidly than operating expenses, and accumulation will advance at a quicker pace.

Such an important problem as the organization of wages depends mainly on the proper connection between the level of wages and labor productivity.

In any branch of production turning out similar products the best unit of measure for labor productivity is the number of products made, expressed in natural units per worker during the report period.

A financial unit of measure, in current or fixed prices, must be used in cases where production is not homogeneous, wherein the use of physical units, weights and measures, and other units such as pieces, meters, tons, etc, is impossible.

Shipping is the product of transportation, and is expressed basically in two units of measure: in ton-kilometers and passenger-kilometers.

It is therefore understandable that in transportation, for a more general determination of labor productivity, these two units of measure are frequently reduced to a single physical unit of measure, usually ton-kilometers.

Average labor productivity in transportation is measured specifically in ton-kilometers resulting from the shipment of goods, including economic and service shipments, and ton-kilometers derived from recaltulating passenger-kilometers carried during the given time period, expressed per worker employed in the operational group.

The reference unit in this formulation is the work unit, or the work time of one worker. Depending on the need work-hours, work-days, months, quarters, or years are used for calculations.

The possibility of using in calculations only a physical unit, i.e., ton-kilometers, opens the way to a direct comparison of various means of transportation in terms of labor productivity.

In the USSR the unit used to measure shipping for this purpose on all means of transportation is the ton-kilometer. In railroad transport the Soviets also use so-called (substitute) equalized ton-kilometers calculated on the assumption that one passenger-kilometer equals one ton-kilometer. This equalization is justified by the fact that the cost of one-passenger-kilometer on the USSR railroads is only slightly higher than the cost of one ton-kilometer.

On the PKP the cost per passenger-kilometer in 1924 was almost equal to that per ton-kilometer; in 1939 it was twice as great; and now it is around 15 percent lower.

Because of this constantly changing relationship between the cost per passenger-kilometer and the cost per ton-kilometer, the PKP has adopted the gross ton-kilometer as the basis for determining total labor productivity. This procedure affords certain advantages, since only one physical unit appears, making further calculations unnecessary: the gross ton-kilometer simultaneously includes the shipment of empty rolling stock.

It should not be overlooked, however, that gross ton-kilometers include not only net shipping production but also the work connected with creating this production. The use of work as well and not only net production, as the basis for determining labor productivity, is inconsistent with what we mean by labor productivity and leads to incorrect conclusions. This is because the creation of a certain volume of net shipping production with bad utilization of railroad rolling stock, and thus with an unnecessarily large number of gross ton-kilometers, will show up in this system of calculations as an increase in labor productivity, which is obviously incorrect.

The use by the PKP of a method of determining labor productivity which is different from that used by other means of transportation has caused considerable difficulties in the direct comparison of results achieved among various means of transportation.

For this reason it has recently been decided, effective 1 January 1952, to determine labor productivity for the PKP also on the basis of substitute ton-kilometers.

In automotive transportation the differences between unit costs in freight and passenger traffic are particularly great: in 1949 the cost per ton-kilometer on the PKP, for example, exceeded the cost per passenger-kilometer by 12-fold. This disparity is being evened out now. The PKP expresses production in financial units in determining labor productivity.

The use of shipping production to determine labor productivity in railroad transportation is possible only as the most general characterization of an operational group throughout the rail network and not in individual okregs.

In carrying individual shipments in the majority of cases two or more okregs participate which usually have different traffic conditions. Some of these okregs have primarily transit shipments, which results in a large number of runs made. Others, on the other hand, show mostly traffic connected with the dispatch or receipt of passengers and freight, resulting in a relatively small number of runs.

In automotive transportation, on the other hand, the use of shipping production to determine labor productivity is possible either for a whole enterprise or for individual economic units (okregs, offices, etc) because of the negligibly small shipping connections between these units.

It is known from transportation economics than when the number of shipments is increased the number of workers employed in an operational group does not increase in direct proportion but rather more slowly. When shipping falls off the number of employees drops less rapidly than the number of shipments. This discrepancy in the rate of change between the number of shipments and the number of employees, other conditions being equal, has a very important effect on the value of the labor-productivity index, a fact which should be kept in mind in evaluating the level of labor productivity at various times.

Labor productivity in individual services or work groups must be expressed in units which give the immediate result (product) of the given service or group. Each means of transportation which uses its own units has developed a large number of indexes showing the labor productivity of individual services or individual groups within the given service. These indexes include:

In railroad transportation:

1. The number of locomotive-kilometers per worker in the mechanical service.

2. The number of locomotive-kilometers per locomotive crew.

3. The number of train-kilometers per worker in traffic service.

4. The number of substitute ton-kilometers per worker in commercial service.

5. The number of work-hours consumed in current repair per 100 locomotive-kilometers or per 10,000 car axle-kilometers.

6. The number of million zlotys of materials turnover per supply-service worker.

7. The number of tons of coal loaded on locomotives per work-day of the particular work groups.

In automotive passenger traffic:

1. The value of shipping production, in fixed prices, per service worker.

2. The number of car-kilometers per service worker.

3. The number of passenger-kilometers per service worker.

In automotive freight traffic:

1. The value of shipping production, in fixed prices, per service worker.

2. The number of car-kilometers per service worker.

3. The number of ton-kilometers per service worker.

In dispatching:

1. The value of services, in fixed prices, per worker employed in dispatching.

2. The number of tons net dispatching per worker employed in dispatching.

3. The number of tons transloaded per transloading worker.

In service stations:

1. The number of work-hours per 100 car-kilometers.

Since analysis of statistical data is properly the job of the organs using statistical tables, attention should be drawn to the fact that the level of labor productivity is determined in part by various factors which must be taken into account in planning labor productivity and in analyzing results. The more important of these factors are:

1. Factors of a social nature:

(a) The growth of political and social consciousness of workers liberated from capitalist exploitation and working for their own welfare, for their own class, for the people's state.

(b) Socialist labor competition, the Stakhanovite movement, the rationalizer movement, etc.

2. Factors connected with natural conditions:

(a) The effect of geographic conditions on the number of workers employed (in railroad transportation these may include difficult line profiles, drops, rises, etc).

(b) The effect of climatic conditions.

3. Factors of a technical nature:

(a) New technical equipment and improvements in existing equipment.

(b) The mechanization of laborious work.

4. The total volume of production, particularly the volume of production of one kind:

5. Factors of an organizational nature:

(a) Timely supplies of raw materials, fuel, and other materials.

(b) The organization of technological processes and the increase in the proportion of normed work.

(c) The preparation of cadres, continual instruction of workers, and increasing their skills.

(d) Proper organization of work.

(e) Planning of work and shipping (particularly minimizing fluctuations, and controlling the fulfillment of planned goals).

(f) Practical application of the discoveries of progressive workers.

(g) Improving labor discipline and avoiding fluidity of manpower.

(h) Improving working conditions and labor safety and hygiene.

Among the factors of an organizational nature which affect the growth of labor productivity one of the most fundamental is proper norming of personnel. This must be based primarily on work norms which define either the work time necessary to perform individual functions or the number of production units which a worker is obliged to turn out per unit time. In either case the norm is based on full utilization both of the working day and of technical equipment and other means of production.

Rational norming cannot be based on maintaining past mean-statistical norms (i.e., based on results achieved in the past). Efforts must rather be made to develop mean progressive norms oriented on the results of progressive workers. Their experience, methods, and achievements will thus find the widest possible practical application, and become the basis for reconstructing the technological process.

Considering the enormous importance of increases in labor productivity for transportation economics, and in view of the connection between labor productivity and the wage level (contract wages), either quantitatively or in a manner taking account of quality, each transportation enterprise must direct its efforts toward raising labor productivity, suppressing or completely eliminating the effect of negative factors and promoting and developing the effect of positive factors.

It is the task of analysis to use the material supplied by reporting and statistics to determine whether and to what degree the results achieved correspond to the efforts made in this direction and to the planned goals.

5. Statistical Compilations

Numerical data on average employment in various groups, on labor turnover and fluidity, on work time expressed in work-days and work-hours, on the number of days and hours of delay broken down into causes of delay, on the number of overtime hours, on the real length of the work day, on absenteeism and its causes, etc, compiled in statistical tables for an entire transportation enterprise and for individual services, are not only of enormous importance for providing a picture of working time and its utilization but they are also the basis for determining labor productivity.

It should be noted that an isolated index giving labor productivity for a particular report period really says very little, since it does not show the dynamics of labor productivity. Statistical compilations on this subject should, therefore, contain as a rule data on labor productivity for a number of report periods within the same long-range plan. These data should be compiled in absolute figures and, for better contrast, also in relative numbers, expressed in percents or in dynamic indexes.

As an example of this type of statistical compilation we may present a part of the table given in V. Z. Umbliya's Osnovy organizatsii normirovaniya i planirovaniya truda na zhelezhodorozhnom transporte [Principles of the Organization of Labor Norming and Planning in Railroad Transport], published in Moscow in 1949, a Polish translation of which is being published by the Communications Publishing House in Warsaw. This table illustrates the indexes of labor productivity and the utilization of employees on Soviet railroads between 1935 and 1940.

Table 8

Index	1935	1936	1937	1938	1939	1940
In Shipping Units per Worker						
Thousands of ton-kilometers	273	340.2	370.7	366.9	384.0	397.2
As a percent of 1935	100	124.6	135.8	134.4	140.6	145.5
Locomotive Crews						
Monthly output per operator in freight traffic during obligatory work time (kilometers)	1,798	2,074	2,264	2,235	2,233	2,384
As a percent of 1935	100	115.4	125.9	124.3	124.3	132.6
Ton-kilometers per crew member (millions)	2.8	3.4	3.8	3.9	3.9	4.2
As a percent of 1935	100	121.4	135.7	139.3	139.3	150
Mean crew size (persons)	2.72	--	--	2.86	2.89	2.9
As a percent of 1935	100	--	--	105.1	106.3	106.6

E. WAGES

1. Wage Systems

Wage increases must be strictly connected with increases in labor productivity such that:

1. Increases in labor productivity must precede wage increases in time, since they are the cause and foundation of wage increases.

2. Increases in labor productivity must not be balanced by such far-reaching wage rises as would be improper or in contradiction with the requirements of socialist accumulation, which is in turn the material foundation for expanded production.

Proper wage organization is in its turn one of the most important factors leading to a rise in labor productivity. Shortcomings in wage organization, on the other hand, not only have a negative effect on labor productivity, they may lead to still another negative phenomenon, i.e., increased labor fluidity.

Existing wage systems are based on payments in proportion to either the quantity of production turned out or the amount of time worked. Among the four basic wage systems used -- normal piecework, progressive piecework, ordinary daily, and bonused daily wages -- the ordinary daily wage is the only one not structurally tied to rises in labor productivity. These wage systems are based on the following principles:

1. The normal piecework wage is paid in proportion to the quantity of production turned out. The wage paid per unit of production does not change regardless of whether and to what degree the worker fulfilled the established work norm.

2. In the progressive-piecework wage system the worker who exceeds established work norms is paid on different scales:

(a) That portion of production turned out within the limits of the obligatory production norm is paid according to the normal wage table.

(b) That portion of production turned out in excess of the obligatory production norm is paid according to a higher scale of wages.

3. In the normal daily (hourly) wage system the wage is calculated according to a wage table, and the quantitative and qualitative indexes of work done are not reflected in the wage. This system represents the payment of wages for time worked and should be used only for workers whose work cannot be calculated and normed with sufficient accuracy.

In the bonused daily-wage system the worker is paid a daily wage and, in addition to the wages calculated according to the wage table, receives a bonus for the fulfillment and overfulfillment of the plan and for achieving certain qualitative work indexes (such as for saving fuel, oil, and materials, for a larger number of runs between repairs, etc). This system is used principally for intellectual workers and certain plant groups.

Both the normal piecework and the progressive piecework wage systems may be organized in the form of an individual or a group system.

In an individual system wages are calculated for each worker depending on the volume of his individual production. The individual system is the most widespread form of wage payment. In the group system wages are calculated on the basis of production by an entire group, and within the group wages are distributed to individual group members depending on the amount of time worked by each worker and his individual position in the wage table. The group system is encountered less frequently.

2. The Wage Fund

The wage fund for a monthly report period includes all payments received by the workers for their work during the given month, particularly basic wages, supplemental wages, special payments, equivalent payments in kind, prices, social payments, and payments for work ordered. The wage fund, on the other hand, does not include other payments, such as reimbursements for travel expenses, service delegations, and scholarships paid to studying workers.

The wage fund for commercial and service units distinguishes two categories of workers:

1. Administrative workers whose wages are not strictly dependent on the degree of completion of planned functions.

2. Operational workers, whose work is closely connected with the fulfillment of the planned functions of the enterprise, and whose wages depend on the degree of fulfillment of these functions.

The final calculations regulating the total payments made to all categories of workers for a given month should be made by the

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15th of the month following the month in which the enterprise made the payments.

The wage fund for a given month also includes payments made at a later date, provided they concern only payments made for work done during the given report month. Thus all later payments relating to the month for which calculations have already been made may be paid only to the extent that the wage fund for the particular month is not yet unexhausted.

The wage fund includes all wage payments ("gross payments"), i.e., without taking note of deductions for taxes or other purposes.

The final calculation and report on the wage fund for an individual report period contains data on the determination of wages as a function of the amount of shipping services produced. These data make it possible to answer questions such as:

1. What was the mean wage paid to administrative workers?

2. What was the size of the wage fund of operational workers in proportion to the amount of services performed?

3. What was the relationship beteeen the percentage performance of planned services per operational worker and the percentage deviation of the mean wage of these workers from the wage envisioned in the wage fund?

3. Subjects Dealt with by Wage Statistics

Wage statistics is concerned with statistical investigations of the relationship existing between changes in the wage level and the rise in labor productivity, while these investigations may extend either to a certain branch of the national economy or to individual portions of the particular branch or may be limited to isolated groups of plan workers.

The relationship between the wage level and the increase in labor productivity shows up in the composition of wages, in the level of wages of various plant groups, in the use of different wage systems, etc. In this connection the program of statistical investigations of wages embraces the following subjects:

1. Composition of the wage fund. This involves characterization of individual component portions of the total wage fund. In the statistical reporting of transportation enterprises the composition of the wage fund contains the following elements: basic wages; a variable portion of the wage (bonuses); all additional payments (the total amount); payments for overtime work; payments for vacations and time not actually worked (in the case of workers).

2. Average wage during the report period. In order to obtain some numerical characteristics various types of workers are grouped according to the average gross wage paid to them (without deductions), and again for each group according to individual systems used for paying employees. In this manner one obtains data on the number and percentage breakdown in each group of workers paid according to various wage systems, as well as other structural indexes.

Only workers who have been on the employment records throughout the report period should be grouped according to the average wage paid. Those workers who were taken on, released, or were sick during the report period should not be cincluded in the group, since distortions will be introduced into the data.

3. The use of various wage systems. In order to obtain relative data three methods are used; each of them has its particular value.

The first method can be reduced to a determination, by the proper grouping, of the number of work hours worked during the report period according to various wage systems. The number of persons employed in work which is paid according to the progressive piecework system should include all workers paid according to this system, even those who did not exceed the work norm during the report period.

The second method consists in grouping the workers (included in the employment report) according to the wage systems used for the work to which they are assigned.

The third method consists essentially in investigating individual components of the wage fund, i.e., in determining indexes characterizing the composition of the wage fund, as discussed in paragraph 1. above.

The purposes of analysis based on the material provided by wage reporting and statistics include:

1. Discovering shortcomings resulting from the use of various wage systems.

2. Discovering discrepancies between the wages of individual plant groups.

3. Establishing preventive measures for eliminating the shortcomings which have been found.

CHAPTER V. MATERIALS STATISTICS

A. THE TASKS OF MATERIALS STATISTICS

The basic job of materials management is to keep the production process continually supplied with the necessary means of production in order to assure uninterrupted production.

The means of production refers to the resources of work and the objects of work. The resources of work will be discussed in more detail in the section entitled "Statistics of Permanent Resources". The objects of work include raw materials (i.e., products of mining and agriculture), intermediate products (i.e., products of the processing industry), and fuels.

These means of production, subjected to division of labor in the production process, result in a certain type of production. A considerable portion of this production represents new means of production which is in turn used in further production processes.

In the process of material supplies there is, therefore, a strict connection and a mutual dependence among individual enterprises and portions of the national economy. The supplying of some enterprises with the necessary means of production is at the same time selling the finished products of other enterprises which produce the particular means of production.

The means of production are in this manner subjected to the process of turnover, whose cycle is composed essentially of the following steps:

1. Supplying production with the necessary means of production.

2. The production process.

3. Realization, or the sale of the finished product.

Materials supplies and sales are therefore the two limiting features which define the turnover cycle of the means of production in their movement from producer to consumer.

On the scale of the national economy material supplies and the sale of finished products are therefore a single process providing the material conditions for simple and expanded reproduction. The organized movement of production from producer to consumer assures the uninterrupted realization (sale) of finished products and the uninterrupted and timely supply of enterprises with the necessary means of production.

Under a socialist economy these relationships occurring in the process of material supplies cannot be arbitrary, but become instead the object of planning. The plan outlines the form and content of materials supplies and determines the most efficient ways of utilizing materials supplies.

The processof turnover of the means of production is different in transportation. In transportation the realization of shipping cannot be separated from the shipping process. As a result the process of turnover of the means of production in transportation is composed of only two steps:

1. Supplying transportation with the necessary means of production.

2. The productive shipping process, which is at the same time the sale of shipping services to the recipients of the services.

In order to gain an idea of the great importance of materials management for each transportation enterprise one needs only point out that in the total of operational expenses, including expenditures for capital repairs made by the transportation enterprises according to the khozraschet method, the proportion of expenditures for materials supplies in 1948 and 1949 varied between 30 and 45 percent, depending on the means of transportation involved.

With materials supplies occupying such an important position particular attention must be directed to seeing how materials management meets the requirements of efficiency and rational management:

1. That it provide a continuing and economic supply of the necessary materials, in the proper quantities, qualities, and on time, as determined in advance.

2. That it avoid blocking the flow of the means of production by the formation of excessive or completely unnecessary reserves.

3. That it provide for the rational utilization of materials by consumers.

These requirements should be realized by:

1. The proper planning of materials supplies, since this plan is a harmonized part of the shipping-finance plan of each transportation enterprise. The supplies plan should specifically be compiled on the basis of a careful determination by the place of work (i.e., by the future consumers of materials) of a detailed plan for the consumption of materials, fuels, and certain equipment necessary for accomplishing the shipping goals envisioned in the plan, and for current and capital repairs made by the khozraschet method. The materials-consumption plan should thus be based on progressive and mobilizing materials-consumption norms worked out with an eye to rational savings.

2. Establishing the volume of warehouse supplies on the basis of the production plan and delivery deadlines, and a strict determination of emergency levels of individual materials.

3. Keeping watch of the consumption of materials and analyzing, controlling, and correcting the adopted consumption norms, since these are the basis of the materials-consumption plan and thus also of the supplies plan.

These basic tasks of rational materials management and methods of realizing them also constitute the subject of materials statistics. This subject is made up specifically of:

1. Materials supplies.

2. Warehousing and turnover of materials in supply points (warehouses).

3. Materials consumption.

Data from records, accounting, and materials reporting are used as source information for materials statistics.

B. MATERIALS SUPPLIES

1. Grouping Materials According to Type and Nomenclature

The requirements of the materials-supply and finance plans make obligatory the following grouping of materials according to type:

1. Basic materials.

2. Auxiliary materials: direct and indirect.

3. Fuels.

4. Packing materials.

5. Low-value and short-term inventory.

6. Spare parts for machinery and technical equipment.

Basic materials (raw materials, semifinished products) make up the basic substance of a product in that they:

1. Either become part of the finished product (as clay in the manufacture of bricks),

2. Or are transformed during the production process, giving new products as a result (such as iron ore in producing iron),

3. Or they are the packing material and as such a part of the product in the form in which it is to be sold, and are thus included in the sale price (such as match-boxes).

Direct auxiliary materials are those used directly in the production process; they are not an essential component part of the new product, but merely impart certain qualities to it (such as dyes, polish, enamel, etc).

Indirect auxiliary materials are those which:

1. Either are not part of the finished product nor impart to it their particular qualities, but whose use is connected with the production process (such as polishing, grinding, veneering materials, etc),

2. Or are used only for preserving productive equipment and keeping it operating,

3. Or are used for general administrative-economic purposes.

The breakdown of materials into basic and auxiliary depends on their role in creating the given product. The same materials may be considered either basic or auxiliary depending on the function which they fulfill in the production process. For example, sand for polishing is an auxiliary material, while sand for concrete production is a basic material. Similarly coal for heating or power is a fuel, while in coking plants it is a basic material.

Low-value and short-term inventory. This category includes objects which are not immediately used, directly or indirectly, in the production process, but because of their small value or limited useful life are not included in permanent resources. This group includes, for instance, working tools, instruments, and measuring instruments, small office, warehouse, and economic equipment, and protective clothing.

This grouping of materials according to type has certain shortcomings since it fails to enumerate permanent inventory, for instance. This grouping, made principally from the point of view of the requirements of the enterprises producing material goods, is only slightly applicable to transportation enterprises. The transportation enterprises are of the service-productive type, and thus do not use basic materials in their operations.

Until this situation is changed the transportation enterprises will continue to use, particularly for planning purposes, a breakdown corresponding to the materials groups in the Uniform Accounts Plan. This grouping is intended primarily for the requirements of financial accounting, and not the requirements of systematization worked out from the point of view of materials management. The use of this breakdown, however, has certain practical aspects, which will be discussed in the section on reporting materials turnover.

The enormous variety of the means of production means that for the purposes of rational materials management they must be included in a schedule containing the names of individual types of raw materials, other materials, fuels, and tolls, broken down into groups according to certain features. This type of technical nomenclature should meet the following requirements:

1. The names of individual types of raw materials, other materials, fuels, and equipment, as well as their classification in the schedule, should be uniform and standardized for all enterprises and organizations which are interested in production, supplies, and consumption of the given materials.

2. The schedule of the means of production should be organized technically; it should correspond to the types, categories, and other qualitative features of the given type of production; and it should coincide with established norms.

The basis for developing such a schedule is usually the specification of products according to types of materials, such as ferrous metals, nonferrous metals, wooden materials, building materials, etc.

The schedules adopted in the balance sheets and plans of individual types of production, as approved by the government, meet to a certain degree the conditions for these uniform schedules of individual types of raw materials, other materials, fuels, and equipment. These schedules are set up according to group positions and are common to all enterprises and organizations producing and consuming the given products. There is really nothing against the further refinement of nomenclature within the framework of this general schedule and expanding it by introducing more names defining in greater detail the categories, qualities, amounts, etc. The need for such supplementation results from the special aspects of production and of supplying individual enterprises in connection with the specific nature of their operations.

The names in the schedule should be set up in a definite order and classified according to groups and subgroups, types, categories, dimensions, and other qualitative features. In the interest of a more succinct indication of the individual product names, symbols, i.e., numerical denotations which have been agreed upon, are used in the schedule for each group, subgroup, category, type, etc.

It should also be noted that warehouse records include a further breakdown of materials into new and used.

2. Delivery Records

The delivery of materials is preceded by a number of formal acts (functions) within the framework of the materials-supplies plan for providing deliveries of materials in a certain quantity, with the necessary quality, and within certain time limits.

These formal acts (functions) include materials requisitions and acquiring allotments, ordering, retail purchase, concluding contracts for materials deliveries, etc.

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Records of materials supplies also include these acts (functions), as well as data on the materials received as a result of these acts.

A special card file is used for the registration of these data; the card file is broken down into types of acts (functions) preceding supply deliveries, i.e., requisitions, ordering, retail purchase, concluding contracts for materials deliveries, etc.

Within the range of each of these sections the card file must be kept according to the established nomenclature of materials to be delivered.

Each card in the card file has at the top headings for entering data defining in closer detail the particular act, such as the number and date of a requisition, the order, the contract, etc; the supplier, the material to be delivered, the quantity and quality of the material, price, deadline, place and means of delivery, financial value of materials to be delivered in the future, etc.

Other headings on the card are for data concerning the "realization" of the material. Information is included on the date of realization and the quantity of material realized, the quantity of faulty material, a determination of the nature of the faults discovered, the quantity of material not accepted because of faults, the quantity of material accepted at reduced price, the amount of price reduction, etc. On the basis of these data special records are kept on delivery deadlines which were not met, contract penalties, etc.

The basis for making these realization records is warehouse receipt reports, shipping documents, copies of suppliers' bills indicating quantity and quality of materials received, records giving the faults found in materials, etc.

Delivery should be distinguished from realization: realization concerns materials assigned to the recipient, regardless of whether the material is in the supplier's warehouse or has merely been assigned to the recipient. Delivery, on the other hand, refers only to material actually sent to the recipient.

The moment of delivery is the moment when, according to the contract or the delivery specifications, the supplier's responsibility for the material ends and the supplier can demand an accounting, settlement, or an acceptance of the bill.

It should be pointed out that materials supplied from outside the given transportation enterprise should be acknowledged quantitatively and qualitatively, while material from internal sources within an enterprise is subject basically only to quantitative acknowledgment. When both quantitative and qualitative acknowledgment are made the qualitative acknowledgment must not coincide with the quantitative one, but should be earlier or later.

In order to keep track of realization from the point of view of individual important groups of materials, regardless of the records kept and described above, it is desirable to keep a separate "group" card file.

For each important group of materials a special card is entered in the card file, with headings for entering data on:

1. The planned requisition of the given material, expressed quantitatively and qualitatively.

2. The actual realization, also quantitatively and qualitatively. Data on material realization are added up monthly. At the end of each quarter 3 months' data on materials realization are added and data are entered on the consumption of materials in the same quarter. Finally, a balance is made out for the following quarter.

3. Statistical Compilations of Materials Supplies

The data contained in these card files are the basis for working out statistical tables showing the realization of individual materials in comparison with the supply plan. The degree of plan fulfillment is characterized by percentage indexes.

Separate statistical tables should contain statistical comparisons concerning:

1. The deadlines for obtaining materials, and

2. The completeness of materials deliveries, i.e., the proportion of deliveries of all spare parts required.

Obviously the failure to deliver materials within specified deadlines, when the necessary spare goods are not available in the warehouse, may cause considerable difficulties in fulfilling the production plan. The same difficulties may be encountered when materials are not received until the end of the month even though, when the matter is considered formally, the monthly supply plan was fulfilled.

The completion of planned work may encounter obstacles when material belonging to the same category is supplied in insufficient quantities. When deliveries of fasteners, for instance, are only around 45 percent of the planned amount, track-laying in the planned amount will be difficult, although track deliveries themselves may have been very high, say around 95 percent.

One of the tasks of materials-supplies statistics is, therefore, to supply analytic data in order to reveal such causes of failure to complete established production plans.

Tables set up according to the index method show the dynamics of deliveries of particular materials over a period of several years. Such tables should show, in the first line, the delivery of material in individual years of the period, in natural or physical units. In the second line the dynamics of the volume of deliveries is characterized by indexes, with those of the first year of the particular period taken as unity (1.00), and deliveries in subsequent years shown in relative figures. If a table is to contain not individual materials but rather groups of materials or the total mass of deliveries, the volume of deliveries should be expressed in financial units instead of natural or physical units. Financial quotas may thus express either the actual cost of acquiring the materials or the value of deliveries in fixed prices. In the former case the table shows the dynamics of expenditures for materials supplies, while in the latter case it shows the dynamics of the physical volume of deliveries.

The qualitative composition of the materials supplied may be indicated by grouping materials according to the system set up in the nomenclature.

An important characteristic, particularly necessary for analyzing the fulfillment of the material-supplies plan, is the grouping of materials delivered according to places of origin, such as planned contracts, on-the-spot purchases, purchases from auxiliary enterprises, from orders, etc.

This latter grouping makes it possible to set up a so-called materials balance sheet. This is the name given to the listing showing the sources from which materials are delivered, indicating the purpose for which they were used (such as capital repairs, medium or current repairs, operational requirements, etc), giving at the same time any remainder. These materials balance sheets may be set up either in natural or physical units or in monetary units. The use of monetary units is necessary especially when the balance sheet deals with a particular group of materials (such as rolled-steel products, wooden goods, etc).

C. MATERIALS WAREHOUSING AND TURNOVER

1. Problems in the Management of Materials Reserves

The principal task of the management of materials reserves is to avoid all types of loss which may result from the improper warehousing of reserves and the irrational turnover of materials. Materials management strives toward this goal by keeping accurate records of material reserves and the turnover of materials, providing for control of the following:

1. Whether the materials being kept agree quantitatively with records entries.

2. Whether materials reserves are being replaced in accordance with established deadline, quantity, and quality requirements, and whether they are replaced within the limits of allotted financial resources.

3. Whether harmful material surpluses remain.

The subject of records is thus the state of materials reserves and turnover -- income and outgo. Registers and reports use natural or physical units (pieces, sets, weights and measures) and monetary units. The simultaneous use of both methods of recording materials management, i.e., quantitatively and with respect to value, is based on the fact that materials supplies must be placed in the framework of quotas allotted for this purpose in the shipping-finance plan, while all requirements and consumption of materials are given in natural or physical units and according to norms based on these units. Planning for materials management thus uses a double method of recording the same item, calculating the necessary materials according to norms expressed in natural and physical units and recalculating the results obtained in terms of monetary quotas. In this connection both the income and the outgo of materials for the requirements of the units serviced must in the final analysis be reduced to a financial accounting.

2. Recorded Materials Prices

The problem of recorded prices of materials can be summed up essentially as the question of whether materials records should be kept in terms of real prices calculated separately for each delivery, or whether they should be based on standard prices, i.e., planned prices established for the particular report period.

The real prices of individual materials are either the catalogue price, diminished by the amount of discounts and increased by possible surcharges and costs; or they are the weighted arithmetic mean resulting from recalculation of the price of previous reserves and the price of the latest delivery of materials. In cases of particular difficulty an estimated price is used in establishing the real price in the above manner.

The level of standard planning prices is established, on the other hand, such that all three components of this price -- the purchase price of the material, the delivery cost, and other charges -- are established from the top, in the plan, by calculating the weighted arithmetic mean of prices resulting from delivery contracts, increased by the average delivery cost and by the average of other costs.

3. Materials Turnover

The turnover of materials is the receipt of materials in the warehouse and their issuance from the warehouse on the basis of income and outgo vouchers. In materials turnover a distinction is made between:

1. Internal turnover, within the scope of an organizational unit operating on the basis of internal khozraschet, and

2. External turnover, extending beyond the scope of such an organization.

An income voucher is a receipt invoice which is the basis of records and bookkeeping of materials. This invoice is sometimes used also as a record of the acceptance of materials by the recipient.

An outgo voucher, which is the basis of registering and bookkeeping of outgo, is an outgo invoice issued by the warehouse on the basis of a materials requisition and an order to issue materials. Materials requisitions are drawn by the organizational unit responsible for the issuance of materials from the warehouse. Part of this requisition is the issuance order, which is carried out by the agency authorized to decide on the issuance of materials.

4. Quantitative Records

Current quantitative records of the state of warehouse reserves and turnover are kept with a special card file based on income and outgo vouchers.

For each type of material, marked with a special catalogue number, and for each measurement a separate card is placed in the card file. Each card has, in addition to a heading for current registration of data on each income and outgo of materials, at the top headings for the account symbol, technical description of the material, binding reserve norms, location of warehouse, etc.

The account symbol mentioned above may be given as a fraction the numerator of which is the number in the quantitative card file, and the denominator of which is the bookkeeping account number of the given group of materials.

The card file is divided into four separate parts, depending on the origin of the materials: From local production deliver-

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ies; returns in exchange for the issuance of new material; scrap salvage and waste which can still be used.

In order to make control easier and to provide faster access to the proper card a special index is usually made for the card file.

The moment at which the material is entered in the records is the moment when it is received in or issued from the warehouse.

The state of reserves in the warehouse is determined by comparing income and outgo, and not by direct counting; this latter method is used only in control and inventory-taking.

5. Quantitative-Value Records

Quantitative-value records of the state and turnover of materials are kept by warehouse bookkeeping with the aid of a special card file. This file has, in addition to headings for the quantity, place also for the value of income, outgo, and final reserves. This card file is the basis of control, and in this sense bookkeeping occupies a superior position in the warehouse.

The account symbol on the cards in the quantitative-value file must correspond to the symbol in the quantitative card file. Entries in the quantitative-value card file must also be made under the same number and position as in the quantitative file. This makes easier the job of current systematic control of the agreement in entries between the two card files. The quantitative-value card file may be kept as a carbon copy of the journal. The only remark to be made is that after each entry concerning turnover the remainder (reserve) is entered under the quantitative and value headings.

The basis of bookkeeping is the income and outgo invoices submitted by the warehouse manager after the proper headings have been filled in.

Materials coming from other organizational units of the transportation enterprise are received according to the prices shown in the internal invoice and in the document from the supplying unit.

6. Reserve Norms

In order to provide for uninterrupted production and the fulfillment of planned goals a certain reserve must be available of the means of production, i.e., of basic materials, auxiliary materials, fuels, etc,which may be used at any time.

The reserves of the means of production available in the enterprise are drawn upon for systematic and direct supplies to the places of work, i.e., those places at which materials are consumed. The warehouse reserve of any given assortment of material is composed of:

1. Productive (current) reserves, and
2. Minimum (safety, guarantee) reserves.

The productive warehouse reserve of a material is that quantity of material -- which may vary with use -- which must be available in the warehouse at a given moment and which is necessary to assure the fulfillment of planned production and maintain uninterrupted operations from the moment when the quantity is measured to the moment the same material may become available from the next delivery. Productive reserves result from the fact that the materials supplies are used not all at once but rather gradually, as they are required, and are later replenished; these reserves are thus variable, depending on the quantity of materials supplied and the time at which they are to be replenished. The maximum production reserve thus equals the planned consumption of material in the period between two consecutive deliveries:

$$Z_{prod.} = T_1 \cdot B_{max.}$$

where $Z_{prod.}$ = the maximum productive reserve,

T_1 = the interval between two successive deliveries, expressed in calendar days rather than working days, and

B_{max} = the average daily consumption of material calculated for one calendar day on the basis of the maximum quarterly consumption during the plan year.

The above formula shows that T_1 should, other things being equal, be a minimum, since only frequent deliveries of smaller quantities of materials can bring about a drop in productive warehouse reserves and thus provide the advantages resulting from accelerated circulation of turnover funds. Working against this are the conditions of material production, transportation, etc (cf. below).

The minimum warehouse materials reserve, Z_{min}, is the quantity of material necessary for planned production and maintaining continuous operations, as calculated for a period of time in which supply is able to deliver and make available for consumption the given material by using extraordinary means of delivery, such as allotments in excess of the plan, special purchases, etc. The minimum reserve may be broken into when the productive reserve has been exhausted because of the failure of a regular delivery to arrive on time or because of a brief and unforeseen increase in the consumption of a given material.

The minimum reserve is basically constant throughout the year. Determination of the amount of this reserve depends on the regularity of supplies and on the possibility of obtaining the particular material through extraordinary deliveries.

The size of the minimum reserve is given by the following formula:

$$Z_{min} = B_{max} \cdot T$$

where T = the time, in calendar days, necessary to obtain material which will ease all the functions connected with allotment, purchase, transportation, and receipt of the given material for supplementing the depleted minimum reserve.

In transportation enterprises, being service-producing enterprises, the minimum reserve is determined only for certain particularly important materials, such as coal, fuels, lubricants, etc. Only a productive reserve is formed of other materials.

The maximum warehouse reserve, Z_{max}, is the sum of the minimum warehouse reserve and the maximum productive reserve:

$$Z_{max} = Z_{min} + Z_{prod}$$

If the maximum reserve is to be expressed in calendar days, then it equals:

$$T + T_1$$

The warehouse normative, N, is the quantity of material in the warehouse denoting the mean state of warehouse reserves, around which the actual warehouse reserve oscillates; the warehouse reserve, in these variations, is not permitted to dropbelow the minimum reserve or to rise above the maximum reserve.

The warehouse normative is calculated fundamentally according to the following formula:

$$N = Z_{min} + \frac{Z_{prod}}{2}$$

If the normative is to be expressed in calendar days, then it equals:

$$T + \frac{T_1}{2}$$

The warehouse normative is used, among other things, to give the monetary value of the warehouse reserves necessary to assure uninterrupted production.

In determining the warehouse production reserve, the maximum warehouse reserve, and the warehouse normative a decisive role is played by the so-called average frequency of deliveries. This is the average time passing between deliveries, calculated in calendar days. The length of the intervals between consecutive deliveries depends, in practice, on the production conditions in the delivering installations and the receiving installations, the possibility of making up shortages of raw materials, etc, the conditions of receipt, transportation conditions, etc. The average frequency of deliveries is given by the following formula:

$$f = \frac{\Sigma nx}{\Sigma n}$$

where f = the average frequency of deliveries, expressed in calendar days;

n = the number of deliveries;

x = the intervals between deliveries, expressed in calendar days; and

Σ = the summation sign.

The emergency warehouse state, I, occurs the moment when the productive reserve falls to a value sufficient to cover consumption only for the period necessary to take real emergency measures to provide for continuous and normal deliveries within the framework of contracts concluded.

When an emergency warehouse state, maximum or minimum, has been reached it is the duty of the card-file keeper in the warehouse to notify the warehouse director so that the necessary emergency steps can be taken.

For spare parts necessary for repairs, and for low-value and short-lived inventory, normatives are not established according to reserves in days, but according to directives outlined in the statistics of turnover resources, in Chapter VI.

The special warehouse reserve, S, is the material reserve formed in the warehouse on orders of a higher unit or other authorized persons. Special reserves may not be used for normal production purposes, and the majority of these reserves, as well as the way in which they are used, must be specified in the order for the formation of these reserves.

Warehouse reserves are among the turnover resources of the transportation enterprise and make up the largest single item in the value of these resources. The maintenance of warehouse reserves on the lowest level permissible under the given working conditions, through establishment of the proper warehouse-reserve norms, is of enormous importance in the struggle to accelerate the circulation of turnover resources, at the same time insuring the enterprise against the losses which may result from protracted warehousing of excessive quantities of materials.

7. Reporting

In addition to keeping the quantitative-value card file, materials bookkeeping is also obliged to make up monthly calculations of materials purchases, in the interest of accounting for deliveries included in delivery invoices and deliveries which did not arrive by the end of the month. Calculations of purchases are also made for purposes of financial bookkeeping.

The report data thus made available to main financial bookkeeping are compiled according to materials groups, for which separate numbers have been set up in the account plan (e.g., 32013: building materials; 32014: tickets and printed matter; 321: fuel; etc). Financial bookkeeping thus keeps report data only in monetary terms, broken down to groups of materials without a quantitative expression. This reporting is distinguished by the fact that;

1. Report data are obtained in an accelerated manner.
2. Report data are at the same time bookkeeping material.

3. Bookkeeping obtains precise data, in monetary terms, on the sources of the materials groups, the consumers of materials (units, services), on the use to which materials are to be put (for operational purposes, for capital repairs), etc.

In those cases, however, in which report data in monetary terms alone are not enough, when quantitative data are also needed (in natural or physical units), and particularly quantitative compilations in a particular system, special reports must be set up.

8. Statistical Compilations

The statistical lists discussed here, in absolute figures or in derived numerical characteristics, describe and characterize the management of materials reserves quantitatively, i.e., in natural or physical units, or in monetary terms. Monetary terms must be used particularly when a given group or unit of warehoused materials is being handled.

The statistical compilations describing the quantitative aspect of the management of materials reserves include the tables presenting the state of reserves and the dynamics of materials outgo. These compilations, like the statistical tables concerning the dynamics of the size of deliveries, will fulfill their mission only if fixed prices are used for comparing report periods. In this case the values in the table will express changes occurring in the physical size of materials reserves or in their outgo.

In order to show the size of changes over a period of many years indexes are used in which, depending on the purpose of the compilations, the values for all subsequent years are expressed as a proportion of the value for the base year (constant-base index), or as a proportion of the year must preceding (chain index). In this latter case the index figures for any given year will express the state of reserves or materials outgo in comparison with the preceding year.

These indexes characterize the total volume of work of a given warehouse or network of warehouses, and are a help in planning materials outgo, norming employment, establishing necessary warehouse size, etc.

On the basis of the state of reserves and the volume of materials outgo one may calculate the so-called turnover quantity characterizing the qualitative aspect of materials-reserve management.

The turnover quantity in a report period for some or all of the warehouse materials is determined by using the index of turnover velocity, according to the formula:

$$O = \frac{R}{S}$$

where O = the turnover quantity in the report period,

R = the total outgo of some or all of the materials in a given period, and

S = the total average remainder of the same materials during the given period.

The average materials remainder is usually calculated as the arithmetic mean of the remainders at the beginning and the end of the report period.

Example. During one quarter fuel worth 2,000,000 zlotys was issued, while the warehouse remainder of fuel at the beginning of the quarter was worth 200,000 zlotys, and that at the end of the quarter 300,000 zlotys.

$$O = \frac{2,000,000}{\frac{(200,000 + 300,000)}{2}} = 8$$

It should be noted that this method of calculating the average remainder can frequently lead to error. It is based on the warehouse remainders reported on only two days, i.e., at the beginning and end of the report. A proper method would be to calculate the average remainder as the arithmetic mean obtained for the remainder on each individual day of the given report period.

The above formula, $O = R/S$, can also be used to calculate the planned volume of turnover, wherein R is the planned outgo of materials and S the warehouse normative, which is in actuality the planned average remainder.

Between the quantity of turnover and the outgo of materials on the one hand, and the average remainder on the other hand, there is a strict relation which makes it possible to calculate one of these quantities if the other two are known:

(1) $R = O \cdot S$, (2) $S = \frac{R}{O}$

It follows from equation (2) above that with a given figure for turnover O the mean remainder or warehouse normative must be higher the higher is the real or planned outgo of materials in the given time period.

Example. An index of turnover velocity equal to 6 was planned for a warehouse for a particular type of material. With a planned annual outgo of 1,800,000 zlotys the warehouse normative will equal 1,800,000/6, or 300,000 zlotys. With an annual outgo of 2,100,000 zlotys, and maintaining the same turnover figure, the mean remainder (or warehouse normative) must rise to 350,000 zlotys.

If the actual outgo of the particular material increases or decreases in relation to the planned outgo the warehouse management, in an effort to achieve the planned turnover figure, must maintain the average remainder on such a level that:

1. It will remain within the limits of the productive warehouse reserve.

2. It will correspond to real needs.

3. The actual outgo of material, divided by the average remainder, will give the same planned index of turnover velocity (equal in the above example to 6).

Turnover time in days, or the duration of a single turnover cycle, is calculated by dividing the number of days in the report period by the number of turnover cycles made during the time period by warehoused material. The formula is:

$$d = \frac{H}{O}$$

where d = the turnover time in days,

H = the number of days in the given time period (taken usually as 30, 90, or 360 days),

O = the number of turnover cycles accomplished by the material during the same period.

The duration of a single turnover cycle in days may also be determined without previous calculation of the number of turnover cycles in the given time period by using the following proportion:

$$R : S = H : d,$$

where R, S, H, and d have the value given above. Thus:

$$d = \frac{S \cdot H}{R}$$

The above proportion has in addition the advantage that if any three values are known the fourth can be calculated in a simple manner:

$$R = \frac{S \cdot H}{d} \quad \text{and} \quad S = \frac{R \cdot d}{H}$$

D. CONSUMPTION OF MATERIALS

1. Registration of Consumption

The reporting and statistics of materials consumption by consumers has the following purposes:

1. To determine the volume of actual utilization of material for operational purposes and for investment and capital repairs done according to the method of khozraschet.

2. To determine whether this consumption corresponds to the requirements of the plan.

3. To control whether the consumption of materials corresponds to established consumption norms, in quantitative and monetary terms, and whether and to what degree directives have been used for reducing materials consumption.

4. To analyze the causes of deviations from the consumption norms.

The outgo invoice, which is issued by the warehouse when it issues material to a consumer, contains data which might be useful for the above purposes, but which cannot be the basis for reporting and statistics on materials consumption by the consumer. For it is not out of the question that the consumer will use material for purposes other than those given in the outgo invoice, that he will use the material in a different report period, or that he will even return some or all of the material to the warehouse as unsatisfactory, unnecessary, etc.

It is clear from this that special reports should be made for consumers, giving information as to when and for what purpose the material obtained was used, whether the use coincided with the plan, and whether it corresponds to established consumption norms. This type of accurate reporting has been done in the past in transportation enterprises for shops (as productive installations), and concerning fuels, lubricants, etc, for operations. The personnel operating rolling-stock units with their own power supply, or units accompanying these, registers on pertinent documents (locomotive-operation reports, road charts, etc) the quantity of fuel and lubricants drawn; this makes possible a determination of total outgo of these materials.

Registration of the consumption of fuel and lubricants on the same document which is at the same time used to register data on the volume of shipping work performed makes it possible not only to calculate the consumption of fuel and lubricants in relation to runs completed or the power of rolling-stock units, but it also presents great possibilities for analyzing the relationship between consumption and various conditions of operation, such as type of vehicle, road profile, and even the individual capacities of engineers, drivers, stokers, etc.

As regards coal management it should be pointed out that entries are registered in warehouse records in terms of weight units of coal actually warehoused. On the scale of overall coal management these units are converted into so-called standard or calculation fuel with 7,000 calories' heat value per kilogram. For example, 20 tons of coal with a calorie content of 6,500 calories per kilogram equals 18.571 tons of standard coal with a calorie content of 7,000 calories (20 x 6,500/7,000 equals 18.571).

Coal, coke, and briquettes, issued for fuel and other purposes according to established norms, are registered separately.

Report data on materials consumption may be grouped according to two basic features: according to the purposes for which the material was used (such as current repairs of freight cars, general repair of locomotives), and according to the type of material. Combined grouping according to both features gives the most important result: a statistical determination of the consumption of the particular material for a particular purpose and, when necessary, a view of the statistical norms of materials consumption.

2. Materials Consumption Norms

Materials consumption norms are of particular importance for a careful and realistic preparation of the enterprise supply plan and control of plan fulfillment. Planning of materials supplies begins with the lower organizational units which consume material, since only they can realistically and carefully plan for materials consumption. Their consumption plan is the basis on which the transportation enterprise bases its entire supply plan.

The materials-consumption plan worked out by the lower units must in turn be based on consumption norms. Even small errors in establishing proper consumption norms for goods used in large quantity may cause serious errors in establishing materials consumption and thus in planning supplies.

The materials-consumption norm is the gross quantity of material absolutely necessary, which is to be used in a certain production technique for producing a unit of homogeneous product. This norm is expressed per unit of labor or unit time.

Depending on the manner in which they are established, materials-consumption norms are divided into technical and statistical.

Technical materials-consumption norms are set on the basis of measurements and calculations, taking into account all the technical conditions of consumption, and the progress achieved.

The statistical materials-consumption norm represents the quantity of material determined on the basis of analysis of statistical data concerning the actual utilization of materials in individual time periods or on the basis of the series of various products turned out; this is the quantity necessary per unit of homogeneous product, or per unit of labor or time.

Statistical consumption norms in industry are more of a transitional norm, leading to the calculation of proper technical norms, the calculation of which is difficult and complicated. Simmilar transitory significance is possessed by statistical norms in transportation enterprises, particularly in regard to production installations (e.g., shops), road building, etc.

In order to establish statistical norms the real unit materials consumption is calculated according to the formula:

$$P = \frac{R}{Q}$$

where P = the real unit consumption of material,

R = the total quantity of material used, and

Q = the quantity of homogeneous product turned out or the quantity of work completed, or the time during which the material was consumed.

In selecting the unit of reference of Q one must keep in mind the practicality and ease of application of the norm which will be established on the basis of statistical data.

In railroad transportation, for example, it has been a matter of controversy for some time whether coal consumption by locomotives should be calculated in relation to locomotive runs (per 100 locomotive-kilometers) or in relation to the shipping work accomplished (per 1,000 gross ton-kilometers).

Statistical data on materials consumption are registered at the place of work where the material is consumed, on so-called cards for the calculation of statistical materials-consumption norms. Each card is to contain only a single group of materials and a single purpose for which the materials were used.

Statistical data on materials consumption may also be obtained from the warehouse card file, from copies of warehouse outgo invoices, from consumption books, etc.

Established consumption norms must not be mean statistical norms, but must instead be mean-progressive norms. This means that in comparison with statistical data the real consumption of materials, the norms should be set at a more economical level than the unit materials consumption which can be achieved under the given conditions.

Statistical consumption norms worked out for individual organizational units may differ in size, since they are not only based on different statistical consumption data, but must also take into account local operating conditions.

The index of materials consumption is the relationship (calculated for an entire transportation enterprise or for individual higher-echelon organizational units of such an enterprise) between the quantity of material consumed on the one hand and, on the other hand, the quantity of product or work turned out or the time during which the material was consumed.

The index of materials consumption will be used particularly:

1. For current and periodic control of materials consumption on an overall scale.

2. For current and periodic comparison of materials consumption in various organizational units or periods of time.

3. For planning changes in the materials-consumption norms.

4. For establishing the general requirement for basic materials.

This index is calculated according to the formula:

$$W_z = \frac{R}{Q}$$

where W_z = the index of materials consumption,

R = the total quantity of material consumed in a given higher-echelon organizational unit or throughout an entire network, and

Q = the quantity of product or work turned out, or the value of these, or the time during which the materials were consumed.

The above formula is similar to the formula used for calculating the real unit materials consumption, and the differences in the definitions of R and Q in the two formulas consist mainly in the size of the scale or in different units of reference (Q).

The overall index (aggregate index) of unit materials consumption. In comparing unit materials consumption in two different time periods the following points should be noted:

1. It becomes necessary to compare the volume of consumption of homogeneous material for carrying out a large number of similar operations.

2. A comparison must be made of the consumption of various materials for carrying out a large number of different operations.

The note in paragraph 1. above concerns, for instance, the comparative evaluation of coal consumption by locomotives, since all types of coal may be expressed in the same units of standard fuel. The basis for comparison in such cases will be the quantitative consumption of material, and the following formula will be used for calculating the comparative size of the index:

$$K_j = \frac{\Sigma P_1 Q_1}{\Sigma P_o Q_o}$$

where K_j = the aggregate index of unit materials consumption,

P_1 = the unit consumption of material during the report period,

P_o = the unit materials consumption during the base period, and

Q_1 = the amount of work performed during the report period.

The symbol Σ means that the index contains various volumes of work and various unit materials consumption the products of which are to be added up.

Example. During a report period the consumption of gas oil per 100 car-kilometers for Chausson APH 48 buses was 22.5 liters, and for Fiat buses 26.5 liters. During the baseperiod, on the other hand, these respective figures were 22 and 26 liters. During the report period the Chausson buses performed a total of 1,200,000 car-kilometers, while the Fiats ran 480,000 carkilometers. The index of unit consumption of gas oil, calculated according to the above formula, equals:

$$\frac{22.5 \cdot 12{,}000 + 26.5 \cdot 4{,}800}{22 \cdot 12{,}000 + 26 \cdot 4{,}800} = 1.02$$

This means that in the given case unit gas-oil consumption, i.e., consumption per 100 car-kilometers, during the report year rose by 0.02, or 2 percent of the base period.

When the other system is used, i.e., when the unit consumption of various materials for various types of work is compared over two time periods, the comparative evaluation, in view of the variation in the calculation of the materials, cannot be based on a quantitative record of consumption, but must use instead monetary units. For this purpose one may use the formula above provided factors are introduced into the numerator and the denominator representing the catalogue prices from the report period for the materials consumed. This formula then takes the following form:

$$K_j = \frac{\Sigma P_1 Q_1 C_1}{\Sigma P_o Q_o C_o}$$

where K_j = the aggregate index of unit materials consumption.

P_1 = the unit consumption of materials during the report period,

Q_1 = the amount of work performed during the report period,

P_o = the unit materials consumption during the base period, and

C_1 = the catalogue price of the materials consumed during the report period.

The symbol Σ means that the indexes contain various types of work, various units of consumption, and various materials prices, the products of which are to be added up.

For comparing the report period with the planned amounts the value P_o in the above formula should be replaced by P_{pl}, i.e., the planned materials-consumption norms.

CHAPTER VI. FINANCIAL STATISTICS

A. INTRODUCTION

In order to discharge the tasks arising from the national economic plans, the individual ministers may order the formation of state enterprises, upon agreement with the Minister of Finance and with the approval of the Chairman of the PKPG [Panstwowa Komisja Planowania Gospodarczego -- State Commission for Economic Planning].

State enterprises are legal entities and are governed either according to the principles of khozraschet or as budget enterprises, whose income and expenditures are part of the state budget. State transportation enterprises are governed by the principles of khozraschet.

The resources necessary for performing planned tasks are allotted to the state enterprise when it is formed by the minister with the agreement of the Minister of Finance and with the approval of the Chairman of the PKPG. These resources are the basis of the enterprise's operational independence; they may be increased or diminished in cases justified by the economic plans. The resources allotted make up the so-called "self-owned fund" of the enterprise, and include permanent resources and self-owned turnover resources.

The following two sections will discuss in greater detail which components of property are included in permanent resources and which in turnover resources.

Agencies which are not units of the socialist economy cannot be allotted the permanent resources of a state enterprise, nor can they be given the rights of incorporation.

The chairman of the PKPG, in agreement with the Minister of Finance, issues orders determining the principles and the method of assigning by a state enterprise permanent resources to other state enterprises or units of the socialized economy. The permanent resources of a state enterprise cannot be used to meet its monetary obligations.

The prices for shipping services and dispatching performed by transportation enterprises for public use are established in binding tariffs as planning prices. The income based on tariff prices is used by the state transportation enterprises to cover operating costs and taxes from nonfreight operations, and to cover earnings. This tax from nonfreight operations regulates the profitability of state transportation enterprises.

The financial and shipping activity of a state transportation enterprise thus has a material basis in the permanent and turnover funds allotted to the enterprise. The bulk of enterprise income is connected with the performance, according to tariff prices, of shipping services, while the difference between income and operational expenses determines the financial results of the enterprise's operation.

Thus financial statistics takes as its subject permanent resources, turnover resources, incomes, operational expenses, and financial results.

B. PERMANENT RESOURCES

1. The Concept of Permanent Resources

The permanent resources of an enterprise include particularly those items of property which are not consumed entirely during a single use or during a single production cycle, but which continue to keep their original and natural form with only a slight diminution of usefulness, such that they can be used for the production process over a long period of time.

The inventory value of permanent resources of an enterprise, expressed in monetary terms, is shown in class 0, group 00 JPK [Jednolity Plan Kont -- Uniform Account Plan]. It should be noted that this presentation of financial statistics refers to the classification of material bookkeeping according to the currently binding JPK. It should be added that the system of this account plan is undergoing scrutiny and will be changed considerably in the near future.

Group 00 is divided into two subgroups:

000 -- plant permanent resources, used for productive activity (basic and auxiliary) of the transportation enterprise for general administration, operation, production, warehousing, supplies, repairs, etc.

001 -- non-plant permanent resources, used for social welfare, housing management, agriculture, and other non-plant activity.

If the same permanent resources are used for basic and auxiliary enterprise activity and for non-plant purposes, the decision as to whether they are to be assigned to subgroup 000 or 001 will be decided by their primary use.

Subgroup 000, "Plant Permanent Resources", includes the following elements, according to the symbols adopted in the JPK for accounts:

0000 -- Grounds and land.

0001 -- Buildings, construction (connected with buildings or not), and special construction.

0002 -- Machinery and mechanical and electrical-engineering equipment.

0003 -- Immovable technical equipment such as railroad tracks, electrical-engineering equipment, traffic-safety equipment, fixtures, technical gasoline-station equipment, service-station equipment, warehouses, etc.

0004 -- Means of transportation, such as transportation rolling stock, economic equipment, "live" train inventory, etc.

0005 -- Instruments and tools.

0006 -- Movable equipment, and packing materials. This group includes the movable equipment of technical and administrative offices, freight dispatching, warehouses, etc.

Independently of the above breakdown according to the JPK, each basic subgroup, i.e., plant permanent resources and non-plant permanent resources, are divided into functioning and nonfunctioning permanent resources and permanent resources qualified for liquidation.

Assignment to the category of permanent resources is decided by classification criteria which are in turn established by the investment instructions which are binding during a given year of account period. (According to the Instructions for Setting up the Investment Plan for 1952, permament resources include property items the value of which when new exceeds 300 zlotys, in new currency, and whose useful life exeeds one year).

Permanent resources do not, however, include the following items, although they have a long useful life:

1. Property purchased with enterprise turnover resources, such as spare parts for machinery and equipment; shop, office, and operational movable property (inventory); service and protective clothing, etc, recorded in class 3 of the JPK, if they have no features qualifying them for inclusion among permanent resources.

2. Items listed in paragraph 1. above, regardless of their useful life or value so long as they are in reserve warehouses on the material-supplies records.

2. Problems and Methods of the Statistics of Permanent Resources

The tasks of the statistics of permanent resources of a transportation enterprise can be classified as follows:

1. Characterization of permanent resources territorially, organizationally, operationally, and structurally (as discussed in section 1. above) such that:

(a) The territorial and organizational grouping of permanent resources permit a characterization of the breakdown of these resources by individual parts of the transportation enterprise, by lines, and by organizational units.

(b) The operational, productive, and economic grouping make possible a characterization of the structure of the permanent resources.

(c) The grouping according to the state of usefulness for purposes of production and operation (particularly the categories useful, superfluous, unuseable, destroyed, and damaged but not rebuilt) allow a characterization of these resources in terms of their usefulness.

2. From enterprise accumulations the state meets, among other things, expenditures for investment, an expression of which is the increase in permanent resources in all parts of the national economy, including transportation.

For a transportation enterprise permanent resources represent a permanent technical and production foundation for operational activity. Under khozraschet a transportation enterprise is responsible, among other things, for all its permanent resources, for amortizing their value, and for transfers to the amortization fund, for repairs to permanent resources in order to keep them in useful condition, and, ultimately, for fulfillment of the investment plan.

The tasks of statistics in this field include:

(a) Characterizing the degree of utilization of permanent resources and of the related amortization.

(b) Characterizing the degree of increase in the quantity or value of permanent resources.

Thus the tasks of statistics enumerated in paragraphs 1. and 2. above should be understood not only in a static sense, as characterization of the state of permanent resources at a given moment or during a specific time period, but rather in a dynamic sense, i.e., as providing a cross-sectional picture of changes occurring over a specific long-range period with respect to the quantity of permanent resources, their placement, structure, degree of utilization, the type and size of investment for purposes of simple or expanded production, etc.

3. The tasks of the statistics of permanent resources also include development of a basis for determining annual writeoffs to the amortization fund, from which monetary resources are to be drawn for financing capital repairs of permanent resources and for replacing used resources with new ones or larger ones.

In connection with the tasks outlined above statistical investigations and processing must include permanent resources in natural (physical) and monetary units, as well as monetary resourcesintended for the repair or replacement of used and damaged resources, etc.

The statistical material necessary for such a characterization of permanent resources in a static and dynamic sense is obtained by two mutually complementary methods:

1. Complete inventorying. This consists in a listing of permanent resources. A complete inventory is the starting point for all further investigations and compilations. After the completion of a full inventory a current register should be kept of changes occurring afterward, in order to collect data onthe number and condition of permanent resources in natural units, as well as their

value, and information on the monetary resources necessary for capital repairs.

2. Current registration. This involves noting changes occurring in the number or value of permanent resources:

(a) As a result of new investment, acquisition, and amortization: increases from new investment and through the acquisition (purchase) of permanent resources; decreases from amortization of value.

(b) As a result of quantitative changes in permanent resources: increases from the incorporation of another enterprise or plant, and the acquisition of permanent resources; decreases from the removal of a plant, from removal of permanent resources, and from writing off permanent resources which no longer exist.

(c) As a result of revaluing or recounting: increases from enhanced value resulting from revaluing, and from the discovery of permanent resources not previously registered; decreases from the reduction in value resulting from revaluing, and from writing off erroneously registered and nonexistent permanent resources.

Current registration may also include transfers of permanent resources within the same enterprise, associated with possible changes in the number or value of permanent resources.

3. Inventorying Permanent Resources

In April 1952 a special commission was appointed to work out the inventorying of permanent resources throughout the nation. In connection with the work of this commission changes can be expected in the methods given below for the inventorying of permanent resources. The inventorying of self-owned permanent resources may be:

1. Partial, such that one or more groups of permanent resources are listed, or only those in certain organizational units of the enterprise, such as during a control.

2. Complete, such that the listing includes all permanent resources which, as of a certain day, are to be found in all organizational units of the enterprise. This is usually accompanied by a reestimation of values and determination of the degree of utilization.

A complete inventorying of permanent resources in the above sense is usually undertaken only when quite necessary, because of the large amount of work it involves and the associated costs.

It is very important that the inventory register the essential information concerning type, quantity, condition, and value of permanent resources which is necessary for a definitive characterization of permanent resources and the rational management of them.

An example of the features to be taken into account is the partial inventorying of permanent resources made of the PKP in 1950. This was carried to the mechanical shops (now called the repair shops) and other separate economic units such as road, electrical-engineering, and electrical-traction shops, graphic installations, filling stations, ferry-boats, and rail lines. In this inventory special folders were also made for items which:

1. Were in normal use.

2. Were superfluous.

3. Were destroyed or damaged and not rebuilt.

Special folders were also made for plant permanent resources (subgroup 000 JPK) and non-plant permanent resources (subgroup 001 JPK).

The inventory folders contained headings for registering the following important features:

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1. The location (region, inventory area) and name of the service unit in whose position the particular property item being registered was found, and the name of the service to which the inventoried unit belonged.

2. The name of the property item according to the name adopted in the nomenclature of permanent resources, or in the type classification of property items.

3. The number of the final JPK classification series for the given property item.

4. The size (number) of the property item according to measurements and calculations, given in units of measure adopted in the nomenclature of permanent resources.

5. The initial value of the property item when new, given in fixed prices and in current prices.

6. The year in which the installation and equipment were built and the year when they were last rebuilt.

7. The degree of wear of the property item, in percents as of the moment of the inventory.

8. The total amortization of the property item as of the moment of the inventory; this is the product of the initial value and the degree of wear.

9. The net value of the property item as of the moment of the inventory; this is the difference between the initial value and the total amortization.

10. The characteristics of the property item in technical, financial, and economic terms.

The periodic inventory, which is made at the end of each year for reasons connected with drawing up the annual balance sheet, should be distinguished frmm the inventory of self-owned permanent resources which is discussed in this section. The periodic inventory referred to means a list of all items of permanent resources and turnover resources which are at the disposal of the enterprise, regardless of whether they are owned by the enterprise. This inventory also includes a determination and harmonizing of all financial calculations. Permanent resources are, for this purpose, listed essentially without evaluation, while data on value are included in the inventory according to book value.

4. Classification of Permanent Resources

The large number and variety of permanent resources means that for purposes of inventorying and the rational management of permanent resources they must be included in a report containing the names of individual permanent property items, broken down into groups according to definite features.

This type of compilation of accepted names coupled with more detailed characteristics is called the nomenclature of permanent resources, while the breakdown into groups according to definite features is called the type classification of permanent resources.

The nomenclature of permanent resources differs from the nomenclature used in materials management or in shipping statistics since permanent resources are not fundamentally an object of materials management, and only a part of permanent resources can be an object of shipping, i.e., movable property.

The type classification of permanent resources is based on the fundamental classified system of permanent resources in the JPK. Thus the classification symbols are established according to the symbols used by the JPK.

The relationship noted between classification and symbols used means that the condition of permanent resources and changes in their quantity and quality can be entered in the books according to the particular accounts, sub-accounts, and entries, in monetary units.

The classification and symbols used for permanent resources, discussed in section 1 above, referred only to the main classification according to the series of "accounts" in terms of class, group, and subgroup in the JPK. The main classification divides permanent resources into subgroups and accounts according to the economic aspects of the purposes for which the permanent resources are intended.

The type classification of permanent resources is not limited, however, to the series of accounts, but is extended to the series of subaccounts, entries, and subentries, and when necessary the breakdown of property items can be carried further, depending on the distinctive and characteristic features.

The features according to which grouping of permanent resources is intensified in type classification must be selected such that the classification will be simultaneously a basis for calculating the volume of amortization writeoffs. For this purpose permanent resources with the same economic use should be divided into groups according to the material of which they are made, and into groups with a mean (normal) life expectancy. In this particular case the probable life expectancy of objects in the given group is determined experimentally.

With a knowledge, from records, of the exact time when the given object was included in the permanent resources of an enterprise, and knowing from the nomenclature of the particular tables the mean life expectancy of the group of given objects, the following can be calculated:

1. The percentage consumption of the given object, as the percentage relationship of the actual useful life of the object to its mean life expectancy.

2. The percentage usefulness of the given object, as the percentage relationship of the time during which the given object will still probably be useful to the mean life expectancy.

Clearly the sum of the percentage consumption and the percentage usefulness of a given object will equal 100 percent.

5. Estimating the Value of Permanent Resources

During inventorying of permanent resources the value of each object is determined in two forms:

1. As the original value, which refers to the value of the object when new, and

2. As the real value, taking into account its past use, i.e., the value of the object at the moment of the inventory.

The original value means essentially the cost of production, corresponding to the expenditure which would be necessary to produce the given object in new condition at the moment of the inventory. The original value in this sense is therefore independent of the real amount of expenditure made for construction or purchase of the given object.

Various factors may sometimes argue for other methods of determining original value. In the example already given of the partial inventory of permanent resources on the PKP in 1950 the unit value in fixed prices as of 1938-1939 was taken for determining original value. The original value obtained in this manner, i.e., determined on the basis of fixed prices, was then recalculated in another column in current zlotys (i.e., in zlotys before the monetary reform of 1950), using a factor of 80 for this purpose.

The evaluation of permanent resources according to the cost of production thus expresses the expenditure necessary to replace the given permanent resources by new resources. This evaluation is the basis for determining the volume of amortization writeoffs, but it does not give the real, present-day value of the permanent resources taking utilization into account. The value of each object, taking into account utilization, is obtained by multiplying its production price by the percentage usefulness.

6. Records of Permanent Resources

It is most convenient to keep records of permanent resources by the card-file method. For each object a special card is made out with headings for entering data from the inventory folders.

In order to simplify record-keeping on mass permanent resources a different type of card is kept; this is the group card. On individual cards objects are entered according to a homogeneous classification and are grouped according to a given territorial feature (i.e., existence on a given line, in a given division, etc).

Changes in the quantity or value of permanent resources which have occurred after the completion of the inventory are entered currently on the particular cards and headings.

7. Amortization of the Value of Permanent Resources

Permanent resources are used in the course of production; the rate of consumption in individual cases differs sharply from the mean life expectancy for a given group of permanent resources, depending on the intensity of the production process and the method of utilization and maintenance. The value of permanent resources is thus diminished constantly during the period of utilization and is transferred gradually to the goods produced. As of the end of their service life permanent resources represent only their liquidation value, as used goods, scrap, etc. Rational mangement demands that the usefulness of permanent resources be upheld by careful maintenance and by current and capital repairs, and that permanent resources which have been used up completely be replaced by new ones.

Maintenance, current repairs, and medium repairs are paid for out of operating expenses. Resources for the production of permanent property items which have been completely used up are accumulated in the form of the particular amortization fund. For this purpose the original value of the given group of resources should be amortized (reduced) annually by an amount corresponding to the mean annual utilization. The amortization sum established in this fashion should be in the form of a so-called amortization writeoff transferred to the amortization fund for creating the given property items.

The amount of amortization writeoff for amortizing the original value of permanent resources is calculated as a percent of their original value, according to the formula:

$$O_u = \frac{100}{T}$$

where O_u = the amount of amortization writeoff for amortizing the original value of the permanent resources, and

T = the mean life expectancy of the given group of permanent resources under normal operating conditions, expressed in years.

The mean life expectancy of a given group of permanet resources is determined experimentally from the results of using it under so-called "normal operating conditions", which should include, among other things, maintaining the usefulness of the property item by the making of necessary repairs.

Monetary resources for capital repairs are accumulated in a special amortization fund through another type of percentage calculation of the original value of the permanent resources, the following formula:

$$O_{rkap} = \frac{I \cdot K \cdot 100}{T \cdot W_p}$$

where O_{rkap} = the amount of writeoff to the capital-repair amortization fund, as a percent of the original value, I = the volume of capital repairs during the mean life expectancy of the given property item,

K = the cost of a single capital repair,

T = the mean life expectancy of the property items in the given group under normal operating conditions, and

W_p = the original value of a property item in the given group.

The value of the common amortization writeoff, O_{com}, which contains both the writeoff for amortizing the original value of permanent resources and the writeoff for capital repairs, is calculated as a percent of the original value of the permanent resources according to the following formula:

$$O_{com} = \frac{(W_p + I\,K)\,100}{T\,W_p}$$

It should be noted that these formulas do not take into account the liquidation value of permanent resources of the costs of liquidation.

Requirements connected with financing investment on a nationwide scale have meant that the value of amortization writeoffs has recently been normed in a slightly different manner.

The new financial system, introduced by the resolution of the Council of Ministers of 17 April 1950, deals with the matter of financing capital repairs and investment. The total percentage of the amortization fund is established for a given branch of the national economy. Supervisory units are authorized to determine that portion of the amortization fund which is intended for capital repairs, as a percentage of the total amortization fund of individual subordinate units of the enterprises. Unused resources from the amortization fund for cppital repairs are transferred in principle to the following year.

The investments of state enterprises envisioned in the investment plan are to be financed thus:

1. From the amortization fund remaining after a portion has been set aside for capital repairs,

2. From the state budget, and

3. From unlimited resources specified in detailed regulations.

8. Statistical Compilations

The data contained in inventory lists and supplemented by current registration of changes in the quantity and value of permanent resources make it possible to work out a number of statistical compilations describing and characterizing the permanent resources possessed by the enterprise. In order to obtain derived numerical characteristics the collected material should be grouped according to value features.

The purpose of the statistical compilations is to describe and characterize the value and the qualitative structure (composition) of permanent resources.

The first category includes primarily compilations of the volume of permanent resources calculated in absolute figures according to certain dates, or mean figures for a given time period. In the latter case the mean values are calculated as the arithmetic mean of the value of permanent resources existng at the beginning and end of a given time period. This type of compilation, in the form of a cumulative series embracing a period of several years, gives a picture of changes in the permanent resources possessed during individual years of the time period.

In order to reveal the intensity of changes these series are also worked out in terms of dynamic indexes -- constant-base and chain indexes -- with the series set up according to the chain-index method showing changes in the rate of growth. The working out of cumulative series depends on reducing the value of permanent resources for given years to the same prices. In this case the indexes will at the same time show the physical changes in the size of the given group or in the permanent resources as a whole.

These series may be worked out in a number of variations for all permanent resources of a transportation enterprise or for individual groups of property items, in order to:

1. Make a comparative evaluation of the relative rates of growth, and

2. To characterize the permanent resources possessed as well as changes in the permanent resources possessed either in individual okregs, main lines, other first-class lines, second-class lines, certain segments, etc (territorial grouping), or in individual services, etc (functional-organizational grouping).

These compilations take on particular significance if they embrace time periods which coincide with the span of long-range economic plans, and thus characterize the scope of achievements made in the accumulation of permanent resources and the rate of growth in individual years of the long-range plan.

This same group of compilations characterizing the volume of permanent resources possessed includes also lists of the mean quantity of permanent resources possessed per kilometer of individual lines, the result of dividing the value of the particular permanent resources in zlotys by the operational length of the given line in kilometers. Mean values calculated in this manner can be used in a general way to characterize the relationship between individual okregs, lines, segments, etc, with respect to the quantity of permanent resources possessed.

The qualitative structure (composition) of permanent resources is determined by grouping data on the value of permanent resources according to type classification, calculating the percentage share of the individual groups of permanent resources in relation to the whole.

The calculation of these characteristic values according to the original value of the permanent resources, i.e., fundamentally according to the cost of production, does not present great difficulties.

If, on the other hand, these data are to represent the real, current value of permanent resources, taking into account the degree of utilization, calculations can be based on the so-called mean percentage of useful life of the permanent resources. It should be noted that the percentage of useful life of any given object is the time during which the object will probably still be useful as a percent of the mean useful life. Thus the mean percentage of useful life of a given group of objects (or of all permanent resources) will equal, percentagewise, the relationship of the real value of the objects in the given group (i.e., including the degree of utilization) to their value in terms of production cost. This is thus nothing but the arithmetic mean of individual indexes (percentages) of useful life weighted according to the cost of producing individual items.

Calculation of the mean percentage of useful life of a given group of permanent resources may therefore be based on the following formula:

$$\bar{P} = \frac{P \cdot C_o}{C_o}$$

where $\bar{P}$ = the mean percentage of useful life of the group of objects,

P = the percentage of useful life of individual objects, and

C_o = the cost of producing individual items.

Example. One of a group of three trucks cost 84,000 zlotys to produce and has 40 percent of its useful life left; the second

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cost 54,000 zlotys and has 50 percent of its useful life remaining; and the third cost 74,100 zlotys and 70 percent of its useful life lies ahead of it. The mean percentage of useful life remaining to all three trucks is:

$$\bar{P} = \frac{(40 \times 84{,}000) + (50 \times 54{,}000) + (70 \times 74{,}100)}{84{,}000 + 54{,}000 + 74{,}100} = 53.07 \text{ percent.}$$

The series of indexes characterizing the qualitative structure includes the so-called index of newness of permanent resources, which gives the percentage relationship between the value of new property items obtained after a given date or during a given time period and the value of all permanent resources.

Example. The value of all permanent resources as of 1 January 1950 was 203,000,000 zlotys, of which 11,000,000 zlotys represented the value of property items obtained after 1 January 1949. The index of newness of permanent resources for the period from 1 January 1949 to 1 January 1950 equals:

$$\frac{11 \times 100}{203} = 5.4 \text{ percent.}$$

Another basis for calculating the index of newness of permanent resources is natural and physical units instead of monetary units. In this case the calculation must be limited to a group of homogeneous objects which can be measured or expressed in the same physical or natural units: e.g., freight card and trucks in tons' capacity, buildings in cubic content, railroad ties in units, etc.

C. TURNOVER RESOURCES

1. The Concept of Turnover Resources

In the production process, as was pointed out above, a man uses tools (included among the so-called permanent resources) to operate on the object of work in order to achieve the desired production effect. The objects of work include, above all, raw materials, fuel, and other materials. The objects of work participate in only one production cycle, since they are either part of the finished product or they are used during production (fuel, lubricants, motor fuels, polishing materials, etc). The value of the objects of work becomes part of the value of the finished product or service. The enterprise obtains a return on the value of objects of work consumed when it realizes (sells) its production.

The objects of work make up the lion's share of the so-called turnover resources. Turnover resources include in addition production in progress, finished products, financial resources, etc.

The turnover resources at the disposal of the enterprise pass from one form to another during their turnover cycle, in the following sequence:

The financial (monetary) form, as cash resources and reserves in the treasury and in bank accounts, checking accounts, etc.

The form of the objects of work, such as raw materials, fuels, other materials, and semifinished products.

The productive form, as work in progress.

The goods form, as finished production.

The financial (monetary) form, following the realization of the finished production and ready to embark on a new turnover cycle.

In transportation-dispatching enterprises the forms are the productive form, as services in progress; and the goods form, as finished service production. These coalesce in a single form, since shipping-dispatching services cannot be produced in reserve, but are "consumed" as soon as they are created.

The turnover resources at the disposal of the enterprise are found, at any given moment, in various forms side-by-side, which assures the technological continuity of the production process.

The forms of turnover resources enumerated above can be divided into two basic groups:

1. Turnover resources in the production process. These include:

(a) Materials, fuel, and inventory in reserve, and materials and fuel drawn for production which has not yet been completed;

(b) Materials and fuel on the road; and

(c) Tools and inventory being used, with the exception of objects included in permanent resources.

2. Turnover resources in the turnover process. This includes finished production (goods or services produced, such as shipping services) and resources in the financial form, such as cash, bank accounts, checks, bills of exchange, valuable papers, and various kinds of bills).

Self-owned turnover resources return, after each passage through the production and turnover process, to the disposal of the enterprise, where they may be used again in the turnover cycle. The volume of self-owned turnover resources is determined by the financial plan.

From the standpoint of financing methods, the division of turnover resources into so-called normed and non-normed is very important.

The following turnover resources are basically subject to norming: basic materials, auxiliary materials, fuel, packing material, spare parts for machinery and equipment, nonpermanent objects, goods, finished products, production in progress, semifinished products, scrap, and active accounts. The total of normatives established for the individual components of turnover resources is the combined normative of turnover resources.

The turnover resources not enumerated above (e.g., monetary resources in the bank) are not subject to norming.

The normatives of the turnover resources of an enterprise should be met entirely or partly by the enterprise's own funds or by negative balances remaining permanently as part of the enterprise's turnover.

Newly created enterprises are allotted their own funds from the state budget in order to meet the normatives of turnover resources.

Permanent negative balances, which are used to meet normatives of turnover resources, should, insofar as usage permits, be made equal to the enterprise's own fund. Permanent negative balances include in particular:

1. Normal indebtedness of the enterprise to its workers for wages paid for work done plus normal indebtedness for social welfare.

2. Indebtedness of the enterprise to suppliers for supplies delivered.

3. Income of past account periods (prepayments), etc.

Gaps in meeting normatives which are discovered at the beginning of the year in connection with establishing the plan or during the year as a result of an increase in normatives caused by an expansion of planned economic goals of the enterprise, are made up in part from enterprise earnings and, if this is not sufficient, from allotments provided in the state budget. Any surplus in turnover resources in excess of normatives must be paid into the state budget by the enterprise.

Temporarily increased requirements of an enterprise for turnover resources, if these requirements exceed the scope of enterprise funds and permanent negative balances, are met by bank credits issued under individual headings, such as:

1. Normative credits, intended to supplement the enterprise's own turnover funds and to credit turnover.

2. Credits in excess of normatives, intended for financing turnover resources in excess of normatives, having a seasonal nature or connected with surpassing the production plan.

3. Treasury credits, based on invoices for deliveries made and services and work performed.

4. Import and export credits and other credits under special headings.

The organization of turnover of turnover resources is of enormous importance to an enterprise, since efforts connected with supplementation of turnover resources and the improved utilization of these resources comprise the majority of the entire financial activity of an enterprise.

2. Normatives of Turnover Resources

It was enumerated above in detail which turnover resources are subject to norming. The normed turnover resources include particularly the objects of work (raw materials, fuel, other materials). In the total of all turnover resources with which transportation enterprises operate, an important percentage actually is devoted to the objects of work, i.e., normed turnover resources.

The total of normed turnover resources is determined by the enterprise financial plan in an amount sufficient for the proper achievement of planned production goals by the enterprise without hindrance.

The volume of non-normed turnover resources, on the other hand, depends directly on the enterprise itself, on its financial-production activity and the state of its accounts settlements.

The structure of turnover resources in the production process differs fundamentally in transportation enterprises from the structure of these resources in enterprises producing material goods. In these latter enterprises around 45-62 percent of turnover resources is allotted to raw materials and basic materials, which make up the majority of the finished products. In transportation the objects of work are not part of finished shipping production; they are intended principally for use during the shipping process (fuel, lubricants) or for other operational needs, and for repairs of permanent resources, such as rolling stock, rail lines, etc.

In transportation enterprises, therefore, the structure of turnover resources in the production process does not include all raw materials and auxiliary materials; on the contrary, the proportion of auxiliary materials (including materials intended for maintaining permanent resources), low-value instruments, small inventory, etc, and fuel and lubricants above all, exceeds 90 percent.

The amount of the planned total of turnover resources necessary for the operational activity of a transportation enterprise is determined on the basis of the shipping-financial plan. The total of these resources is directly proportional to the planned volume of shipping and repairs.

In the case of transportation enterprises the majority of turnover resources which are simultaneously in the production process and in the turnover process is included in operational-production units. A smaller precentage (from 11 to 47 percent), depending on the type of materials, is kept in the form of warehoused materials.

For individual groups of normed turnover resources normatives are established whose significance corresponds to warehouse normatives -- in monetary units, of course. The purpose of normatives is:

1. To determine the volume, i.e., the reserve, of a given group of turnover resources sufficient to assure the uninterrupted production process.

2. To prevent the excessive accumulation of turnover resources.

The inactivation of common resources by the creation of excessive reserves of turnover resources impedes the use of these resources in other forms or to meet other needs; it particularly hampers the expansion of production. It should also be kept in mind that operating with smaller quantities of turnover resources saves labor and expenses connected with storing materials, records, etc.

It is apparent from materials statistics (cf. the section entitled Reserve Norms) that the warehouse normative can be expressed as either:

1. The planned mean level of the warehouse reserve for the given material, in natural units, or

2. The number of calendar days for which the warehouse reserve is to suffice.

The normatives of turnover resources based only on monetary units and not natural units are equally important. In this respect normatives are a planned indication of the monetary value of the median level (reserve) of the particular part of turnover resources necessary to assure uninterrupted production.

The normative of turnover resources in monetary units is determined for each portion (group) of turnover resources on the basis of the plan for operational expenditures and of the reserve norm for the given group of resources, expressed in calendar days. For this purpose the planned annual outgo of the given group of materials is divided by 360 and the quotient obtained multiplied by the established reserve norm in days.

Normatives are not determined for the following groups of turnover resources: monetary resources and irregular accounts with suppliers and clients.

The volume of normatives is determined as of the end of the planning period, e.g., the normative for the first quarter is determined as of the first of April, which makes it a sort of base norm for the second quarter.

Normatives, like all reserves norms, are not and cannot be fixed quantities. Changes in the level of normatives are primarily the result of:

1. Increases or decreases in the volume of production in individual months or quarters of the year, which in turn change the volume of outgo (turnover) of the particular group of turnover resources.

2. Changes in the reserves norm, expressed in calendar days.

The turnover-resources normative is calculated using the folbwing general formula, which includes the factors enumerated above:

$$N_{tr} = \frac{W \cdot N_z}{H}$$

where N_{tr} = the normative of normed turnover resources,

W = expenditures according to the plan for operational expenditures for the given group of turnover resources for the planning period,

N_z = the reserves norm, in days, for the given group of turnover resources, and

H = the length of the planning period, in days (30, 90, or 360 days).

The normative of a given group of turnover resources is essentially the planned mean reserve in monetary units. For purposes of reporting and for control of the degree to which the real reserve corresponds to plan indications it is sufficient for the given group of turnover resources to calculate the average bookkeep-

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ing balanse (mean remainder) during the report period. The bookkeeping balance expressed as a percent of the normative is the desired index of the degree of fulfillment of the goals of planning with respect to the normative.

If all the organizational units of a transportation enterprise are obliged to maintain the same number of calendar days' warehouse reserve, there will be nothing against calculating the normative once for the entire enterprise. When this is done the value of W in the above formula will equal the sum of the outgo separately for all organizational units in the enterprise. The percentage index which characterizes the degree of fulfillment of this group normative may be calculated by adding up the individual average bookkeeping balances for all organizational units in the enterprise during the report period and dividing the sum by the overall normative.

The normative of spare parts necessary for repairs, and the normative of low-value and short-lived inventory are determined usually only in monetary terms, and not in days' reserve. The normative of spare parts is therefore calculated in groszy per zloty of mean annual value of the particular production equipment, machinery, rolling stock, etc. The normative of low-value and short-lived inventory is established in terms of the composition and type of these objects, the number of workers, machinery, rolling stock, and other equipment. The reserve in days would be extremely complicated to determine in the above cases and, in cases of complex organization of transportation, would not always give reliable results.

3. Circulation Velocity of Turnover Resources

The circulation velocity, which is also called the speed of rotation, is the rate at which turnover resources pass from one form to the next form in their movement.

Acceleration of the velocity of turnover resources, i.e., reducing the time during which they remain in unchanged form before proceeding to the next form, i.e., from the monetary form to the form of objects of work, etc, is of great importance for the enterprises concerned and for the entire national economy as well.

Reducing the time during which turnover resources remain in individual forms makes it possible for the enterprise to create a smaller quantity of turnover resources with the same level of production. The portion of turnover resources released in this fashion may, like common resources, be used for other production purposes or within the same enterprise to expand production.

In the operation of transportation enterprises the production form of turnover resources, as work in progress, usually lasts but a short time, while the goods form, as finished product, is completely lacking. As a result turnover resources pass from the monetary form into the form of the objects of work (reserves of fuel and materials) from which, after being used in the production process, they pass again into the monetary form, as income from shipping completed.

The problem of accelerating the circulation of turnover resources in transportation enterprises therefore requires that particular attention be directed to speeding up the turnover of resources, particularly in materials and fuels reserves and in bills issued for services rendered.

For this purpose normatives established for those groups of turnover resources cannot be treated as fixed quantities, but must be systematically reviewed and corrected from the point of view of accelerating the circulation of turnover resources.

The speed of turnover of the total volume of turnover resources or of individual groups of turnover resources is expressed by the turnover during a report period and by the time, in days, required per turnover cycle.

The index of the number of cycles completed during a report period by a given group of turnover resources in a given form is calculated according to the formula:

$$O = \frac{W}{S}$$

where O = the number of cycles during the report period,

W = the total outgo (turnover) entered in the books at the end of a certain number of turnover cycles during the given period,

S = the mean remainder (average balance) at the end of the given group of turnover cycles, also during the given time period.

In the above formula the value of O is relative, giving the relationship between two comparable quantities. Calculation shows how many times the average balance must be "turned over" in order to obtain the sum of outgo recorded for the given group of turnover resources.

On the basis of the above formula the planned number of turnover cycles is calculated for the given group of turnover resources. In this case:

W = the planned operational expenditures for the given group of turnover resources during the planning period, and

S = the normative of the given group of turnover resources (the planned mean reserve, in monetary units).

The index of the number of turnover cycles completed during a report period by all turnover resources of an enterprise, including those derived from outside sources, regardless of the form in which they existed during that time, is calculated from a similar formula:

$$O = \frac{K}{S}$$

where O = the number of turnover cycles during the report period,

K = the total production cost of the services rendered during the report period, calculated according to real unit production costs or, when such calculations are not possible, according to planned unit production costs,

S = the average total of balances of all turnover resources resulting from balance sheets, such as financial resources, materials and fuel, production and services in progress, and accounts receivable.

In order to compare the value obtained for O in the planned value K (i.e., the total of production or services realized during the report period) should be calculated according to planned unit production costs, since otherwise one will be comparing heterogeneous quantities.

In the USSR a circular of the Ministry of Finance and the Central Statistical Office in 1949 demanded different calculation of the number of turnover cycles completed during a report period by all the turnover resources of an enterprise, including those obtained from outside. This required taking as K the total of production realized during the report period, in wholesale prices, not including the turnover tax.

An increase in the number of turnover cycles (acceleration of turnover) of turnover resources results not only in a reduction in the average total of turnover resources functioning in the enterprise (i.e., S) but usually brings with it also a drop in unit production costs. This latter in turn causes a diminution of the total sum of realized production calculated according to unit production costs (i.e., K). In view of the simultaneous reduction in the size of K and S, the number of turnover cycles resulting from the method of calculating the total realization of production according to unit production costs is not favorable to the enterprise.

The method of calculating all turnover cycles ordered by the circular mentioned above was therefore intended to avoid these shortcomings, thus making it possible to reveal the impedimenta in the program to reduce unit production costs. For if K in these calculations is taken as the total realization of production in sale prices, then considerable acceleration may be shown in the rate of turnover even when production costs have dropped.

The circular further ordered taking as S the average sum of balances of all turnover resources resulting from balance sheets, with the exception of the average sum of monetary resources in the operational bank account. The elimination from S of this portion of turnover resources is intended, on the one hand, to eliminate the phenomenon of accelerated turnover resulting from materials reserves, work in progress, and finished production all in excess of norms; on the other hand it was designed to take into account the fact that monetary resources in an operational account increase bank reserves and make it possible to finance production in other enterprises.

The method of calculating the turnover rate of turnover resources used in the USSR has recently been introduced in Poland. It should be noted that within the USSR this procedure has opponents who consider it to be in conflict with theoretical principles and to contain serious practical shortcomings.

In order to calculate the index of the number of turnover cycles completed during a report period by all turnover resources of an enterprise, including those obtained from outside, the following formula is also used:

$$O = \frac{S}{K}$$

which is the inverse of the preceding formula, expressing the volume of turnover resources per zloty of realization. It shows that quantity of turnover resources which is engaged during a given report period in producing one zloty worth of realized production (services).

Duration of one turnover cycle in days. If the number of turnover cycles completed by turnover resources during a report (or planning) period are known, the duration of a single cycle in days can be determined from the following formula:

$$d = \frac{H}{O}$$

where d = the duration of a single turnover cycle in days,

H = the length of the planning or report period in days (30, 90, or 360 days), and

O = the number of turnover cycles during the given report or planning period.

The duration of a single turnover cycle in days for a given group of turnover resources can be determined without using the above calculation of the number of cycles in a given time period, by using the proportion:

$$W : S = H : d,$$

where W, S, H, and d have the value given above. Thus $d = \frac{S \cdot H}{W}$.

When this formula is used to calculate the duration of a single turnover cycle in days for all the turnover resources of an enterprise, including those obtained from outside, the value of W should be replaced by that of K, with the reservations given earlier.

The above proportion has the advantage that if the values of any three expressions are known it is easy to calculate the unknown value of the fourth expression in the proportion. Thus one may specifically calculate the number of turnover cycles necessary if the duration of a single cycle is changed:

$$S = \frac{W \cdot d}{H}$$

or, in calculating the sum of all turnover resources of an enterprise, including those obtained from outside:

$$S = \frac{K \cdot d}{H}$$

4. Reporting and Statistical Compilations

The periodic financial reports of transportation enterprises which will be described in more detail in section F of this chapter include numerical data, in monetary units, concerning the mean turnover resources of the enterprises according to the situation as of the end of the report month. These data show:

1. The volume of turnover resources and their structure (composition) by individual forms, and

2. The distribution of turnover resources, specifically their division among organizational units which are operating under khozraschet.

In setting up statistical compilations on the basis of the numerical data mentioned above it should be kept in mind that in considering turnover resources one is dealing with mass phenomena which rapidly change their intensity with respect to time around certain mean values, and which do this not in the cumulative fashion of permanent resources. In calculation, therefore, only dynamic series are used, while in statistical compilations involving annual periods the use of monthly intervals is very important. In view of the close connection between the size and structure of turnover resources and the size and quality of shipping production, compilations according to monthly intervals make analysis much easier.

Statistical compilation involving turnover resources have, in addition, the applications mentioned in the paragraph devoted to statistical tables on the permanent resources possessed.

Monthly financial reports include, in addition, numerical data making it possible to calculate the number of turnover cycles completed in a report period by a certain group of turnover resources or by all turnover resources of the enterprise, including those obtained from outside; these reports also contain calculations of the duration of a single turnover cycle in days.

The final values calculated in this way give a proper picture of the management of turnover resources only in comparison with corresponding planned quantities.

The progress achieved in the management of turnover funds is indicated in the tables which compare these final values for a number of report periods, particularly those within the same long-range-plan period.

D. INCOME

1. The Concept of Income and Its Structure in Transportation Enterprises

The income of a transportation enterprise, which is also called realization, is divided into operational and nonoperational income. Operational income is the total of monetary resources received as a result of operational activity, under the following headings:

1. Payments for shipping services, particularly for shipping passengers, baggage, and express shipments, freight, mail, economic shipments, and for economic trains (in railroad transportation).

2. Payments for services indirectly connected with shipping, and for reimbursed services such as telegraph payments, and for warehousing, advertising, etc.

Nonoperational income includes income from non-plant activity (such as income from leased equipment, rents from housing and shops for commercial use, industrial installation, and other leased buildings) and income from the sale of materials.

Payments for shipping services are obviously the most important for transportation enterprises.

The task of reporting and statistics in respect to income is to prepare the statistical material necessary for control and analysis of the fulfillment of the realization plan. These tasks of statistics require certain preliminary remarks as to the moment of realization and the breakdown of income among okreg enterprises (directorates).

Regardless of whether the sender is obliged to take upon himself the payment of charges for sending shipments or whether the charges may be billed to the recipient the final determination of the amount of shipping charges may not be made until the shipment is made. Not until then are all the tariff and other data available which are necessary for a final calculation of charges. In this manner reporting on the final amount of income from shipments is removed in time and space from reporting associated with the conclusion of individual shipping contracts.

On the other hand the income from shipping passengers is entered in the treasury books essentially as of the moment tickets are sold, and it is with this moment that reporting is connected. Only in the case of passenger travel on credit is cash income separated from the moment of reporting.

In the interest of proper performance of service and operational activities by socialized transportation, the individual means of transportation are organized into operationally independent regional units (okreg directorates or enterprises), which also report on the given okreg to the extent of compiling okreg balance sheets, settling accounts with the state treasury, etc.

If a given shipment was completed by only one okreg directorate, i.e., within the limit of its territory and its resources, it is not difficult to calculate the income from shipping, both owing and entered in the books, earned entirely by the given okreg directorate.

If, on the other hand, two and more okreg directorates participate in a given shipment, as usually happens in railroad transportation, there is a problem of the degree to which each should participate in the income from the shipment. This income may, for instance, be received by the okreg directorate at the station from which the shipment was sent and may be included in the reports of that directorate; but it may not be the income of that okreg directorate alone. The income of an okreg directorate is only that sum which is properly owing to it for the shipping work accomplished by it.

The division of shipping income among okreg directorates of the state railroads is done at monthly intervals by the Ministry of Railroads, by taking as a basis the calculations of shipping work completed during the report period by individual okreg directorates, expressed in axle-kilometers and in sending-receiving units, multiplied by the planned production cost of these units. The Ministry of Railroads makes payments for this purpose -- so-called index income -- from the Central Shipping Account, which handles all income from the entire PKP network. (A new system has in the meantime been worked out by the Ministry of Railroads and is binding as of 1 January 1953; in this system the division of income from shipping is based on the breakdown of shipping-tariff payments received among DOKP [okreg directorates of the state railroads?] in proportion to their participation in passenger and freight runs.)

The PKS have no need of this sort of division of income, since automotive shipments are limited primarily to the territory and the shipping centers of each PKS okreg directorate or PKS branch, while the few shipments in which two organizational units participate are settled by direct negotiations between the parties concerned.

2. Reporting

The reports sent to the okreg directorates and containing lists of income from shipping and from supplemental tariff payments take into account income as separate items, since it is a consequence of individual shipping invoices.

During further control work the initial basing of reporting on separate income items loses its significance, since the volume of the income does not depend on the number of items but on the total number of zlotys received.

The source material from which report data on shipping income are drawn is:

1. Shipping invoices or copies of them, as in shipping schedules, etc -- in shipping freight;

2. Official records of ticket offices such as the ticket-sales journal, the report of blanket tickets issued, the reports of tickets sold by ticket-printing machines, etc -- in passenger traffic.

There are the following reasons for basing reporting on separate income items:

1. Report units include in their reports the vouchers in their possession, which confirm the agreement between the data in individual items and the true state of affairs. These vouchers include schedules of shipping sheets, the backs or sections of blanket tickets, etc.

2. In each item of income a number of features is registered, making it possible to work out in a more general way the characteristics of the income received.

Reports on rail passenger shipping include such information as the type of train used for shipping (express, local), the class of car, the tariff used (normal, reduced), the distance traveled in kilometers, etc. Reports on freight shipping show the report period, the type of shipment, (ordinary, express), the weight of the shipment, the number of pieces and the surface area of a car used for shipping individual live animals. All reports contain, as their most important entry, the amount of cash income received from the given item.

Report compilations are set up separately for income derived from transporting passengers, baggage, express, freight, etc. These compilations are sent by the reporting units to their okreg directorates which, after controlling them, communicate the data in them concerning income to their supervisory organs in the form of group reports.

3. Analysis of Income

Neither the volume of income given in absolute figures nor the percentage index of income-plan fulfillment in and of itself can provide a sufficient basis for characterizing the operation of the okreg directorates connected with fulfilling the income plan. In order to obtain such a characterization one must analyze the extent to which individual types of shipping work contributed to the income actually received and what effect they had on the degree of fulfillment of the income plan. The discussion of this type of analysis given below is based on the overall work of I. V. Kochetov et al. entitled Zheleznodorozhnaya statistika [Railroad Statistics], Moscow, 1939.

Since the receipt of the income envisioned in the shipping-financial plan is closely connected with the fulfillment of the shipping-production plan, the analysis discussed here must make a comparison between the size of income obtained and the volume of shipping production completed. Such a comparison provides the mean income level per unit of completed production, according to the formula:

$$d = \frac{D}{pl}$$

where d = the mean income level,

D = the total income from a particular type of shipping, and

pl = the completed shipping production of the given type, such as the number of ton-kilometers of freight shipments, the number of passenger-kilometers, etc.

If the size of the actual income differs from the planned income with agreement in the mean income levels, i.e., agreement between the planned and actual levels, the cause of such a deviation must lie in the difference between the volume of planned and actual shipping production.

The size of actual income is the result not only of the amount of shipping production but also of the income-producing value of that production. If deviations are found between the actual and planned mean income levels this may be the consequence of any of the following:

1. A structural change in shipping, particularly changes in the numerical relationship between passengers or freight carried at higher or lower tariff rates.

2. Tariff changes introduced in the meantime.

3. Changes in the mean distance transported, in kilometers. It is a known fact that with an increase in the mean distance shipped, keeping the same differential structure of tariff rates,

the average payment received per kilometer shipped will be less than it was when the mean distance shipped was shorter.

If the deviation of the mean income level from the planned level was caused by the combined effect of two or even all three of the factors enumerated above, then the task of analysis will be to determine the degree to which the deviation can be ascribed to each factor. The analysis is carried out such that the effect of each factor is determined separately, assuming temporarily that the other factor had no effect whatever on the deviation in the mean income level.

In order to determine, for instance, the degree to which structural changes in shipping affected the deviation one should calculate the mean income level for the report period at fixed (planned) tariff rates, and then divide by the mean income level planned for that period. As a result one obtains a relative figure (an index) showing the degree of deviation resulting from only the following structural changes:

$$o = \frac{\Sigma d_o \cdot pl_1}{\Sigma pl_1} : \frac{\Sigma d_o \cdot pl_o}{\Sigma pl_1} = \frac{\Sigma d_o \cdot pl_1}{\Sigma d_o \quad pl_o} \cdot \frac{\Sigma pl_o}{\Sigma pl_1}$$

where o = the deiiation in the mean income level (the relative figure sought),

d_o = the mean planned income level,

pl_1 = the mean number of runs during the report period,

and

pl_o = the planned number of runs.

If during the report period the mean deviation in the income level was the result not only of changes in the structure of shipping but also of tariff changes, then the result of the change in tariff rates alone will be given by the index:

$$W_t = \frac{\Sigma d_1 \ pl_1]}{\Sigma d_o \ pl_1}$$

where W_t = the index of the tariff deviation of the mean income level, i.e., the relative size of the tariff changes in the two periods being compared, and

D_1 = the actual mean income level during the report period.

The index of tariff deviation is thus the relationship of the total income from a given type of shipping during a report period to the total income resulting from shipping production during the report period but calculated according to the planned mean income level.

The unit operating cost of the means of transportation decreases along with increases in the mean distance transported. This fact is taken into account in the structure of tariff rates, wherein the tariff payment per kilometer over short distances is generally much higher than the corresponding rate over greater distances. The tariff rate per kilometer does not, however, decline in proportion to the distance transported.

The deviation in the mean income level behaves similarly when the mean distance transported in kilometers increases or decreases. A change in the mean distance transported for the entire mass of freight carried can be the result of increasing or decreasing the distance over which low-tariff freight is carried; this changes the mean income level only slightly. But the situation will be quite different if high-tariff goods are the ones carried over a longer or shorter distance.

Because of the highly complex nature of deviations in the mean income level, i.e., those resulting from changes in the mean distance transported, it is for practical purposes impossible to express the amount of these deviations according to mathematical formulas.

4. Statistical Compilations

Among the more important statistical compilations concerning incomes we may mention tables giving:

1. The dynamics of incomes over a period of several years:

(a) In absolute figures, i.e., in monetary units;

(b) In dynamic indexes, taking the total income for the first year of the particular long-range period (i.e., the base year) as 1.00 or 100;

2. Income from a given type of shipping compared with the volume of similar shipping production and the resulting mean income level. If compilations of this type are worked out for a long-range period their dynamics should also be expressed both in absolute figures and in dynamic indexes.

3. The structure of incomes during a given annual or long-range period, compared with the planned structure. In compilations for an annual period one should use absolute figures and indexes of structure, while in compilations for a long-range period one should also use dynamic indexes.

E. OPERATIONAL EXPENDITURES

1. The Concept of Operational Expenditures

The term operational expenditures is applied to the sum of expenditures by a transportation enterprise in connection with its production-shipping activity.

In terms of structure (composition) the operational expenditures of transportation enterprises can be divided into the following four basic groups, whose percentage share of the total is given in parentheses: Payments for labor, including social welfare (50); payments for fuel, materials, electric power, etc, used for traction, repairs, etc (33); amortization writeoffs from the total of permanent resources used for productive purposes (10); miscellaneous (less than 10).

These figures, referring to the percentage share of the individual groups of expenditures in the total of operational expenditures, should be considered merely as an estimate. The relative size of these expenditures differs in individual means of transportation; those, for instance, for amortization writeoffs in automotive transportation and in civil aviation exceed 10 percent, while they are below 10 percent on the railroads.

Because of the very complex nature of production-shipping functions, certain operational expenditures cannot be decisively attributed to any one of the first three groups. Expenditures of this type belong therefore to the group called "miscellaneous". This group includes, for example, expenditures for "foreign" work (services), performed for a transportation enterprise by other enterprises.

The transportation enterprises have relatively little effect on their own income. The volume of shipping depends on the transportation requirements of the national economy and is determined in the state shipping plans. The amount of tariff payments for shipping is set by superior agencies, depending on the assumptions made concerning the economic policies of the state.

Under these conditions the basic obligations of each transportation enterprise in regard to operational income are limited essentially to:

1. Compiling a realistic operational-income plan in harmony with the facts of the shipping plan and the level of binding tariffs, which are essentially planned prices for shipping services.

2. Watching over the correct fulfillment of the income plan (realization).

The management of a transportation enterprise has, on the other hand, complete operating freedom within the limits of binding regulations and within the limits of binding prices for materials and services. Statistics on operational expenditures cannot, therefore, be limited to a passive registration of the volume of expenditures and their grouping according to structure, place of origin, etc; it must also prepare material for investigating the purposefulness of expenditures, and particularly of their operational effectiveness, through comparing the volume of expenditures with the volume of shipping production achieved. Another task of operational-expenditure statistics must be to supply the statistical data necessary for calculating and analyzing the fulfillment of the production-cost plan.

The statistics of operational expenditures therefore play an important and active role in the struggle for efficiency, to reduce unit production costs, and to mobilize the internal reserves of transportation.

2. Statistical Material

The statistics of operational expenditures, like income statistics, is not based on special material collected by special statistical observation organized for the purpose. The documents which operational-expenditure statistics uses are also used for other purposes, and thus represent statistical material for the other branches of transportation statistics and for accounting. These documents are either in the nature of source accounting material or they are current bookkeeping documentation.

The basis for such documents as wage sheets or other lists of reimbursement for work, for the payment of various supplementary wages, bonuses, etc, is source material such as lists of persons, journals, locomotive-operation reports, road charts, etc -- documents intended above all for the statistics of employment, rolling-stock operation, etc.

An outgo voucher, on the other hand, which serves as the basis for the registration and bookkeeping of materials outgo, is the outgo invoice issued by the warehouse on the basis of a materials requisition and an order to issue materials. The materials requisition, which is given out by the organizational unit responsible for the issuance of materials from the warehouse, is a document used primarily for the purposes of warehouse reporting on materials turnover.

Expenditures associated with the purchase of materials, fuel, etc, are not included in operational expenditures. These purchases are intended to supplement reserves and are recorded in class 3 of the JPK. It is only materials, fuels, etc, issued from warehouses for consumption purposes which become objects of operational expenditures (outgo).

Various types of contracts, accounts, etc, constitute the source material for accounting of foreign work and services performed for a transportation enterprise. Each of these documents should contain all the necessary data, giving the issuer and the recipient, the object of work or service, its economic purpose, the time and place of execution, the price, and other data determining the amount of payment.

Operational expenditures are distinguished by the fact that the moment of accounting is connected with completion of the work or the service or the issuance of materials, but it is not simultaneous with the actual payment. This gives rise to so-called permanent negative balances, which are used to cover the normatives of turnover resources. Payments for work and services done during

December, for example, must be accounted to the month of December even when the actual payment was not made until January of the following year.

3. Expenditures According to Type

The JPK, which has hitherto been binding for transportation enterprises, sets aside a special class, the fourth class, for bookkeeping expenses. (The details of the new so-called Branch Account Plan are still being worked out and have not been announced. Thus the JPK must continue to be used, as well as the definition of "expenses" as production expenditures.) The separation of these expenses in bookkeeping and their group breakdown according to type in a special class makes it possible to determine the type structure of operational expenditures and, with the exception of the PKP, makes it considerably easier to discover unit production costs in a manner which is essentially uniform for all means of transportation.

Class 4 of the JPK envisions the following system of breaking down operational expenditures according to type groups:

Group 40: Consumption of materials (basic materials, auxiliary materials, fuel, packing materials, spare parts for machinery and equipment, short-lived objects).

Group 41: Wages to physical workers.

Group 42: Wages to intellectual workers.

Group 43: Power purchases (electric current, gas, water, steam, compressed air).

Group 44: Foreign services (maintenance repairs, transportation, etc).

Group 45: Taxes, public fees, and insurance.

Group 46: Various types of expenditures: rents, service delegations, telecommunications fees, advertizing, exhibitions, books and periodicals, handling costs and bank charges, penalties, subsidies and assistance, etc).

Group 47: Amortization writeoffs.

Group 48: Calculated secondary expenditures.

4. Unit Production Costs

Unit production costs in any enterprise are calculated by dividing the total of expenditures connected with the production of a certain type of objects (so-called production costs) by the number of objects (units) produced. If, for example, a railroad enterprise had operational expenditures equaling 211,200,000 zlotys resulting from the completion of 3.2 billion net ton-kilometers, the unit production cost, or cost per ton-kilometer, would equal 211.2 million divided by 3.2 billion, or 6.6 groszy.

Assuming that this run of 3.2 billion net ton-kilometers required 5,926,000 train-kilometers, the unit cost per train-kilometer would equal 211.2 million divided by 5,926 million, or 35.64 zlotys.

The production costs associated with each passenger-kilometer or ton-kilometer of freight, baggage, and other shipments are defined as the unit shipping costs.

The production costs encountered in traffic, such as the car-axle-kilometer, the train-kilometer, the locomotive-kilometer, etc, in railroad transportation; the car-kilometer in automotive transportation; and the barge-kilometer, the ship-kilometer, the horsepower-kilometer, etc, in inland shipping -- these are all defined as unit traffic costs.

In order to calculate unit shipping or traffic costs, the operational expenditures entered in the books according to the type breakdown in class 4 of the JPK, and referring to operational expenditures, are transformed analytically in two or three stages.

When operational expenditures are calculated in the two-stage system, as is done on the PKP for instance, the stages are as follows:

1. Recording expenditures in the type breakdown in class 4.

2. Recording costs in the purpose breakdown in class 5.

When operational expenditures are calculated according to the three-stage system the individual stages are:

1. Recording expenditures in the breakdown according to place or origin of costs.

3. Recording costs in the calculation breakdown, i.e., in a breakdown permitting the calculation of costs per individual unit of shipping or traffic run. This breakdown is in class 7.

The calculations shown above in paragraphs 2. and 3. are done with the aid of calculation folders. In this fashion the total production cost is obtained in the purpose breakdown or in the calculation breakdown:

1. In passenger traffic, for carrying passengers, baggage, mail, express shipments, etc.

2. In freight traffic, for commercial shipments, economic shipments, etc.

3. In dispatching, for net dispatching, for dispatching wages, etc, depending on the field in which the enterprise operates.

The total production cost of the particular type of shiping can then be established from the total number of shipping or traffic runs completed during the particular time period (e.g., production costs of passenger shipping including the number of passenger-kilometers, car-axle-kilometers, or train-kilometers run in passenger service) in order to obtain the corresponding unit production costs.

In actual practice only the so-called direct costs can, without further calculations, be related simply to the given type of traffic (passenger or freight), and sometimes to the type of shipping. These direct costs include, for example, in railroad passenger transportation: the costs of the conductor crew; the costs of repair, cleaning, inspecting, heating, lighting, and lubricating passenger cars; the costs of maintaining ticket windows, etc.

Other costs, so-called indirect costs, do not relate unequivocally to a single type of traffic or shipping, and must thus be recalculated to find the proper breakdown among the various types of shipping. Indirect costs may be broken down among types of traffic or shipping by using so-called keys, which may be certain units of measure (such as train-kilometers, train-hours, ton-kilometers, car-axle-kilometers, locomotive-kilometers, etc) appropriate to passenger or freight traffic; or they may be other quantities, such as costs previously broken down in some other fashion between passenger and freight traffic.

All calculations of unit production costs in transportation are therefore based on these or other assumptions concerning the method of breakdown of indirect costs.

So-called final calculation determines the results, i.e., the production costs for a given report period, while initial calculations produce planned production costs.

Initial calculations do not usually produce results as precise as final calculations. This lack of precision should be ascribed to the fact that planned operational expenditures, on which initial calculations are based, include considerably less detail than do the final figures on operational expenditures, which contain all the data which bookkeeping can supply.

5. The Use of Internal Reserves to Reduce Production Costs

Reduction of unit production cost is one of the basic tasks of an enterprise since it is one of the decisive factors in the volume of accumulation. A favorable solution of all problems demands the careful use of data on possible sources of saving and on the internal reserves of the transportation enterprise. The internal reserves which can be utilized for this purpose can be summarized in the following points:

1. Fulfillment and, where possible, overfulfillment of the shipping plan, at the same time carefully maintaining rational and smooth shipping operations.

2. Increasing labor productivity; the wide-scale use of socialist labor competition; improving the organization of work together with its mechanization; basing the system of rewards on bonuses paid for plan fulfillment and production quality, for accelerating the turnaround of rolling-stock units, for savings in the consumption of materials, fuel, etc.

3. The wide-scale use of mean-progressive indexes of the utilization of rolling stock and other equipment through the introduction of improvements in the technological production process in order to reduce shipping time, increase vehicle speed, reduce turnaround time and repair time, etc. The concept of the mean-progressive index is discussed in I. F. Yurchenko Sredniye progressivnyye normy na zheleznodorozhnom transporte [Mean Progressive Norms in Railroad Transportation], Moscow, 1950.

4. Increases and improvements in the technical equipment available for work, introducing new types of locomotives, vehicles, and machinery; expanding the mechanization of tedious work, etc.

5. Increasing the mean utilization time of vehicles, machinery, and equipment, reducing down-time and nonproductive operation of locomotives, cars, etc; better utilization of the load capacity of vehicles, increasing the weight of trains, etc.

6. Promoting the mean-progressive norms for the consumption of fuel, materials, spare parts, electric power, the utilization of wastes, etc.

7. Avoiding breakdowns and accidents.

8. Reducing administrative expenditures, rationalizing the system of administration and accounting and reporting work.

9. Utilizing local supplies and replacing imported materials with local ones, etc.

The degree to which skillful release and utilization of these internal reserves can contribute to reducing unit production costs can be seen from the examples presented below. They are from the book of the Soviet author A. S. Chudov entitled Planovaya kalkulatsiya sebestoimosti zheleznodorozhnykh perevozok [The Planned Calculation of the Cost of Railroad Shipping], Moscow, 1947.

A change of one percent in certain derived numerical characteristics of the operation of railroad rolling stock affects unit production costs as shown in Table 9.

Table 9

Percent Change in Unit Production Cost with a One-Percent Change in Derived Numerical Characteristics

Derived Numerical Characteristics	Change in Passenger Traffic	Change in Freight Traffic
Average load per freight-car axle, dynamically expressed	0.23	
Empty freight-car runs, as a percent of empty plus loaded	0.20	
Average gross train weight in loaded direction	0.25	
Runs of extra and pusher locomotives, as a percent of total locomotive runs	0.20	0.20
Number of passengers per car axle		0.40
Size of passenger train		0.20

In all the above items, except the second and fourth, the production costs are directly proportional to the numerical characteristics.

In a certain okreg, with the volume of shipping production equal to 5 billion substitute ton-kilometers and the total of operational costs equal to 330,000,000 costs, the cost of fuel for locomotives equals 30,000,000 zlotys and the cost of current locomotive repair is 15,000,000 zlotys. The problem is to determine the change in shipping costs if the fuel-consumption norms are reduced by 5 percent, the price of a ton of this fuel by 2 percent, and the expense norm for locomotive repair per unit run by 3 percent. As a result of the 5-percent reduction in the fuel-consumption norms production costs will be reduced by 30,000,000 times 5 divided by 330,000,000, or 0.45 percent. A 2-percent drop in the price of fuel will reduce costs by 30,000,000 times 2 divided by 330,000,000, or 0.18 percent. A reduction in the cost of current locomotive repair per unit run equal to 3 percent will result in a drop in production costs of 15,000,000 times 3 divided by 330,000,000, or 0.1 percent.

Thus the unit production, i.e., the production cost per substitute ton-kilometer, will be reduced by 0.45 plus 0.18 plus 0.14 percent, or 0.77 percent.

These examples cannot be considered as recommended simplifications which are to replace rational initial calculations or final calculation of production costs. This type of estimate calculation must assume from the beginning that the percentage share of individual groups of costs in the total cost will remain unchanged throughout various time periods, which is obviously contrary to the actual situation and can lead to false results. The calculation of production costs should be based exclusively on the structure of operational expenditures for the time period included in the calculation.

6. Analysis of Production Costs

The primary task of the analysis of production costs is to discover the reasons why final unit production costs deviate from the corresponding planned costs. Analysis discharges this task when it is carried out frequently enough and in time so that its results can provide a current foundation for effectively countering unfavorable deviations from planned values.

Analysis will be much easier to perform if the initial calculation of production costs and the final calculation follow the same methods. Some possible deviations which have been discovered should be ascribed not so much to concrete causes as to the use of different methods in the initial and final calculations.

The degree to which operational, economic, and similar factors and changes in the structure of operational expenditures affect the structure of unit production costs was shown in section 5, on the use of internal reserves to reduce production costs.

7. Statistical Compilations

Typical statistical compilations concerning operational expenditures are tables giving:

1. The dynamics of operational expenditures over a period of several years:

(a) In absolute figures, i.e., in monetary units.

(b) In relative figures (indexes), taking the total of operational expenditures (outgo) in the first year of the given long-range period as 1.00 or 100.

Statistical compilations of this type will, however, becompletely useful only if they take years in which operational expenditures were structured similarly.

2. The structure of unit production costs during individual years of a given time period.

The considerations enumerated above concerning the necessity of comparing operational expenditures with the same structure obviously refer also to comparative compilations which include unit production costs for various years (periods).

3. The structure of operational expenditures during the given time period broken down to type, perhaps compared with the structure of planned expenditures for the same time period.

The size of individual structural components can be expressed either in monetary units or in figures showing the percentage breakdown of the total operational expenditures.

F. FINANCIAL RESULTS

1. Accumulation, Earnings, and the Profitability of a Transportation Enterprise

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The accumulation of a productive enterprise is the term applied to the surplus of realization of products or services created over the production costs associated with that realization. In transportation enterprises, which produce services, the accumulation thus represents the surplus of realization over the total expenditures, wherein income includes the realization of shipping, refunds on capital work done by the khozraschet method, the realization of non-plant activities, and the realization of materials. In this same calculation, expenditures include overall expenses, including those expenses of non-plant activities and the costs of realization of materials.

The accumulation of a productive enterprise is used to cover the turnover tax and the tax on noncommodity operations, and the remainder represents the earnings or loss of the enterprise. In this manner the earnings of a transportation enterprise is the surplus of realizations (income) over the total of expenditures enumerated above plus the tax on noncommodity operations.

The amount of earnings is determined as a certain percentage of the cost of producing services.

The earnings of an enterprise are divided into portions intended for:

1. The plant fund.

2. Supplementing or increasing the enterprise's own turnover resources. This portion may not be larger than the planned earnings minus:

(a) Ten percent of earnings paid into the income-tax fund.

(b) The portion of earnings intended for the plant fund.

3. Earnings payments into the state budget; this represents the entire remainder of the enterprise's earnings, but not less than 10 percent of earnings.

With the exception of state enterprises -- so-called budget enterprises, whose income and expenditures are included in the state budget -- the remaining state enterprises (including transportation enterprises) are governed by the principles of khozraschet.

The earnings of state transportation enterprises are determined in the shipping-financial plans.

The profitability of an enterprise is the term used to express the percentage relationship between the total profit and the total production costs of the enterprise. If the result of operations is not earnings but a loss, the enterprise isnot profitable.

2. Financial Reporting

In the field of transportation, the following are obliged to submit financial reports containing all the financial results for a given period of operation:

1. Organizational units of a transportation enterprise which follow complete or limited internal khozraschet. Theindividual reports are to be submitted monthly to the administration of each transportation enterprise.

2. Administrations (okreg directorates) of transportation enterprises. These submit reports monthly to their superior units, to the proper department of the Polish National Bank, and to the individual territorial people's councils (for calculation of the tax on noncommodity operations).

3. Superior units of the transportation enterprises. They submit monthly overall reports on the units supervised together with their own reports to their individual ministries, to the Ministry of Finance, and to the Administration of the Polish National Bank.

The monthly financial reports of the units enumerated under 1. above include:

1. A balance sheet, following the established form.

2. A calculation of results.

3. A report on expenses and costs.

The monthly reports of the units enumerated under 2. above include:

1. An overall balance sheet of turnover and balances.

2. An overall calculation of results.

3. An overall net balance.

4. An overall report on fulfillment of the expense and cost plan.

These reports on expenses and costs include, in the introductory (analytical) part, data on labor productivity in monetary units, on the relation of the costs of realization to total realization in sale prices, and on the cost per work-hour. Subsequently the reports contain lists of expenses according to the type breakdown called for in class 4 of the JPK.

The units enumerated in 4 and 2. above also submit each quarter:

1. An analytical compilation of normed resources in the form of materials on the road, materials and fuel in reserve, and production in progress.

2. An analytical compilation of permanent resources, self-owned funds, and the covering of normatives.

3. A comparative calculation of results, as a comparison of planned and actual values.

3. Statistical Compilations

The important quantities characterizing the financial results of a transportation enterprise include the profitability meationed above and the so-called coefficient of operation. This latter is calculated by dividing the total operational costs over a given time period (usually a year) by the total income.

When the coefficient equals unity operational costs are equal to income; as costs exceed income the value of the coefficient exceeds unity, while if income is greater than expenses the coefficient drops below one.

The value of this coefficient is frequently expressed as a percent, wherein the coefficient equals the total costs multiplied by 100 and divided by the total income.

Until recently on the PKP the value of this coefficient could be calculated only for the entire network, and then perhaps broken down to normal-gauge and narrow-gauge lines. It did not become possible to determine the value of the coefficient of operation for individual directorate okregs until their own income was allotted to them.

The coefficient of operation is not a reliable index for characterizing the financial results of a transportation enterprise, since the income indirectly reflects the level of tariff rates, which depends to only a minimum degree on the individual transportation enterprise.

Improvement or worsening in the results defined by the coefficient of operation can be seen from tables compiled for a period of several years. Under a planned socialist economy these tables present the true state of affairs only when:

1. They are compiled from the proper planned values;

2. They contain operational outgo in the same structure in individual years of the period;

3. They reflect years with similar general economic conditions.

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